Organic status and dietary role of *organoponicos* in Cienfuegos, Cuba

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DEDICATION

This thesis is dedicated to the people of Cuba who's innovation and perseverance I truly admire. The Cubans' relentless sense of hope and optimism inspired me. I feel honoured to have had the opportunity to conduct this work in a country with such intriguing and passionate people.

Cienfuegos Tiene Su Guaguanco ~ (verses from a popular song by Victor Lay)

Hoy siento gran emocion.
Voy a cantarle a mi tierra:
A esa famosa region
Llamada "perla surena"

Su mujer es un primor
Radiante como una estrella
Y por su elegante andar
La admiran en Cuba entera

Cienfuegos, yo a ti te llevo
Metido en mi corazon
Per eso con orgullo
Te doy esta inspiracion.
Ya tulo ves, mi hermano,
Cienfuegos tiene su guaguanco

Today I feel great emotion.
I am going to sing for my city
that famous region
known as the "pearl of the south"

Her women are beauties
they shine like stars and are
admired by the whole of Cuba
for their elegant ways

Cienfuegos, I carry you
in my heart
so, with great pride
I dedicate this song to you
So you see, my brother
Cienfuegos has her own guaguanco.

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ABSTRACT

During the 1990s, Cuba experienced the emergence of a nation-wide urban agriculture movement as an alternative source for food security. Numerous types of urban food production systems have developed including *organoponicos,* where cultivation takes place in container beds filled with a mixture of soil and compost. The literature surrounding the Cuban urban agricultural experience refers to the production in cities as “organic”, or based on organic principles. Not only has urban agriculture been hailed as a successful strategy in dealing with the food security issue, there is also evidence to suggest that the urban gardens have transformed the Cuban diet by introducing a wider variety of vegetables.

In this research, two elements of the Cuban urban agriculture movement were studied. In the first, Canadian minimum organic certification standards were used as an operational definition with which to examine *organoponicos* in the city of Cienfuegos, Cuba. One *organoponico* was studied in detail while complementary information was collected from 10 other *organoponicos*. As part of the case study, a nutrient limitation experiment was conducted to determine possible nutrient deficiencies in the system. This was complimented by leaf tissue and soil analyses. The second component of this study involved a preliminary examination of the contributions *organoponicos* have made to people’s diets in Cienfuegos.

There were no significant differences between the mean yields of the treatments used in the nutrient limitation experiment. The leaf tissue analysis indicated non-limiting levels on nitrogen, phosphorus and potassium while the soil tests revealed excess in phosphorus and potassium. There was no evidence to suggest any significant nutrient limitations. Furthermore, soil tests did not reveal any heavy metal contamination in the case study *organoponico.* The information obtained from the case study garden along with information from 10 other *organoponicos* was used to assess whether the practices followed in these operations meet Canadian organic standards. The practices of the *organoponicos* in Cienfuegos, are not in full compliance with all of the standards. However, the Cubans are practising a form of ecological agriculture that is “functionally organic” in that the major flows of the system are organic. These systems have successfully contributed to food security during the Special Period. With relatively few changes in practices the *organoponicos* could qualify for organic certification under the minimum Canadian organic standards.

In the dietary study the vast majority of participants (73%) claimed they consume more vegetables now than prior to the Special Period. Approximately, 61% of the participants are consuming some kind of vegetable on a daily basis. Age and family size of the participants were not found to be factors affecting consumption patterns and vegetable preference. However, income is likely playing a significant role given the economic difficulties and continuing food shortages. The most consumed vegetables in Cienfuegos are lettuce, tomatoes and string beans while spinach is the least consumed.

This research supports the notion that the Special Period has transformed the Cuban diet by introducing more vegetables to the diet. This change in diet suggests that the Special Period and subsequent development of urban agriculture have to some extent, broken traditional prejudices against eating vegetables.

GLOSSARY

Agromercado: farmers' market

Audit trail: a documentation control procedure that is sufficient to determine the origin, transfer of ownership and supply chain of any product labelled as organic or containing organic ingredients.

Autoconsumos: self-provisioning gardens that belong to and produce for the workers of a factory or institution; they supply the cafeterias of a particular workplace.

Bodega: state food outlet

Buffer zones: a clearly defined and identifiable boundary area bordering an organic production unit that is established to limit inadvertent application or contact of prohibited substances from adjacent non-organic areas.

*Cachaza***:** composted sugarcane crop residues that are used as a fertility input.

Canteros: container beds used in *organoponicos* where crops are planted.

Food security: as defined by the Community Food Security Network, it is the notion of long term self-sufficiency through a nutritionally adequate and culturally appropriate regular food source (Fisher 1996).

Huertos Intensivos: these are intensive urban gardens where crops are cultivated in raised beds.

Integrated Pest Management (IPM): an approach that attempts to protect the health of plants by reducing the use of chemicals and replacing them with cultural and biological controls.

Jeffes: bosses, managers

Libreta: food ration book

Mercaditos: food outlets

Patios and *parcelas*: home gardens

Special Period in Peacetime: commonly known, as the "Special Period" is Cuba's economic crisis that was offset by the dissolution of its main trading partner, the Soviet Union in 1989; was labelled "Special Period in Peacetime" because measures were taken that are normally limited to wartime, such as planned blackouts and the use of bicycles for mass transportation in order to conserve fuel.

Tabaquina: natural insecticide made with tobacco crop residues. It is especially effective against aphids and whiteflies.

Viandas: are root crops such as cassava, taro, potatoes, sweet potato and include plantain.

ACRONYMS

CGSB	Canadian General Standards Board
CCME	Canadian Council of Ministers of the Environment
COG	Canadian Organic Growers
GMOs	Genetically Modified organisms
HUS	Hemolytic Uremic Syndrome
IDRC	International Development Research Centre
ITC	International Trade Centre
IPM	Integrated Pest Management
LISA	Low Input Sustainable Agriculture
NPK	Nitrogen, Phosphorus and Potassium
OCIA	Organic Crop Improvement Association
OMRI	Organic Materials Review Institute
UA	Urban Agriculture
US	United States

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CHAPTER 1
INTRODUCTION

> "Now more than ever, the phrase 'economic independence' has meaning.
> We will achieve it through miracles of intelligence, sweat, heart,
> and the consciousness of humankind"

Remarks by Fidel Castro to the 5th Congress of the National System of Agricultural and Forestry Technicians-1991- (in Rosset and Benjamin 1994 p. 33)

During the early 1990s, Cuba experienced the emergence of a nation-wide urban agriculture movement. An economic crisis in Cuba exposed the country's dependency on food imports and seriously threatened food security. In response Cuba has promoted urban agriculture as an alternative source for food security. Currently there are thousands of urban gardens all over the country providing significant quantities of fresh vegetables to the urban population (Altieri *et al.* 1999; Murphy 1999). The literature surrounding the Cuban urban agricultural experience refers to the production in cities as "organic", or based on organic principles, and as low-input agriculture (Altieri *et al*. 1999; Auld 1999; Chaplowe 1998; Warwick 1999; Holtslander 2000). Numerous articles and papers praise Cuba's transition to organic agriculture and international governments have recognised these efforts. In 1999 the Swedish Parliament presented the Cuban Organic Farming Association the "Right Livelihood Award", also known as the "Alternative Nobel Prize" (Warwick 1999).

Not only has urban agriculture been hailed as a successful strategy in dealing with the food security issue, there is also evidence to suggest that the urban gardens have transformed the Cuban diet by introducing a wider variety of vegetables. The food shortages experienced as a result of the economic crisis forced people to incorporate more vegetables in their diet (Murphy 1999).

1.1 Objectives of study

In this research, two elements of the Cuban urban agriculture movement were studied. In the first, Canadian minimum organic certification standards were used as a framework by which to examine *organoponicos* (specialised urban food production systems) in the city of Cienfuegos, Cuba. The second component of this study involved a preliminary examination of the contributions *organoponicos* have made to people's diets.

One *organoponico,* La Calsada (Appendix A map 3), was examined as a case study in detail while supplementary information was obtained for 10 other *organoponicos* in the city of Cienfuegos. As part of the La Calsada study, a nutrient limitation experiment was conducted to reveal possible nutrient deficiencies in the system. The results obtained from the case study, supported by the complementary information on the other gardens, were used to assess the degree to which the *organoponicos* in Cienfuegos meet Canadian organic standards as outlined in the definition and guidelines of the Canadian General Standards Board (CGSB 1999).

For the purposes of this thesis, the term "organic agriculture" is defined as a system of production that adheres to the standards outlined by the Canadian General Standards Board in the document CAN/CGSB-32.310-99. These standards represent the principles used in organic agriculture that promote sound food production and practices that improve the quality and sustainability of the environment (CGSB 1999). The CGSB standards outline the minimum criteria that must be met for the products, inputs and other materials to be defined as "organic" in Canada. Ultimately, this information may prove beneficial to those interested in developing an internationally recognised organic certification process in Cuba.

Focus was placed on the practice of crop production since only one out of the 11 gardens examined was engaged in livestock production. The results of the organic status assessment follow the format typical of an organic inspector's report (where applicable). The CGSB standard includes sections on the following areas:

(a) period of conversion to organic agriculture;
(b) organic production plan and records;
(c) crop production;
(d) livestock production;
(e) specific production requirements for honey, maple products, mushrooms, and organic sprouts;
(f) storage, transportation and processing of organic products;

(g) labelling of organic products and

(h) a permitted substances list.

For the dietary component of the research, 41 patrons of the case study *organoponico* and 3 persons considered experts in the field of nutrition were interviewed. Further information was collected through participatory observations, informal interviews and casual conversations with gardeners and patrons of the gardens.

Home gardening along with nutritional education has been recommended as a long-term food-based strategy in several developing countries to control and eliminate micronutrient malnutrition (Vijayaraghavan *et al*. 1997). In Cuba's case, urban gardening was promoted as a means to deal with extreme food shortages and in an effort to make urban areas more self-sufficient in food production. The objectives of the dietary component of this study were to determine the composition of the Cuban diet, to establish which factors might be influencing people's dietary preferences and to examine the contributions of urban agriculture to people's diets.

1.2 Context

The following sections provide some background information that will introduce the reader to the context of this study.

Cuba

Cuba[1], an island in the West Indies, is located in the Caribbean Sea just 90 miles south of Key West, Florida, at the entrance to the Gulf of Mexico (see Appendix A). Cuba is the largest island in the West Indies and it ranks as the 15th largest island in the world measuring 110,860 Km^2. Cuba's neighbours include Jamaica, the Bahamas, Haiti and the Dominican Republic. Cuba, led by Fidel Castro is the only Communist State in the Western Hemisphere. It has a population of approximately 11,142,000 and its capital, Havana, has a population of 2,241,000. Approximately 68% of Cuba's population live in

[1] The following information has been adapted from Destination Cuba, 24. Jan. 2000; The World Factbook 2000, 10 Jan. 2001; Fried 1999.

urban areas. The language is Spanish and the literacy rate is quite high at 95%. The ethnic composition is 51% mulatto, 37% Spanish, 11% African and 11% Chinese descent.

Most of Cuba is composed of fertile flatlands where sugarcane, coffee and tobacco are grown and cattle are grazed. The island is mountainous in the south-east (Sierra Maestra) and south-central areas (Escambray). Cuba has a subtropical climate with a rainy and dry season. The rainy summer season begins in May and ends in October while the drier winter season runs from November through April. The average temperature reaches 27^{o}C in July and August and 22^{o}C in February.

Cienfuegos: the study site

The city of Cienfuegos is located in the province of Cienfuegos on the South shore of central Cuba and it is often referred to as the “Pearl of the South” (see Appendix A maps 2 & 3). Cienfuegos means ‘one-hundred fires’ and it has a population of approximately 120,000. The city is the marketing and processing centre of a region that produces sugarcane, tobacco, coffee, rice, and rum. Cienfuegos is Cuba’s leading sugar export centre as well as a major fishing port.

Cienfuegos is also known for its urban agriculture. According to Alejandro Socorro (pers. comm. 1999), the province of Cienfuegos is the capital of urban agriculture in Cuba. In 1998, Cienfuegos was recognised by the Ministry of Agriculture as the national leader in urban agriculture with some of the highest yields in the country.

Historical context

In the 1920s, US companies owned two-thirds of Cuba’s farmland and while high taxes crippled Cuba’s manufacturing industries the tourist industry (mainly gambling and prostitution) flourished as a result of US prohibition laws. Following a coup in 1933, Fulgenio Batista seized power in Cuba. Over the next 2 decades subsequent power struggles plunged Cuba into political corruption and social injustice. The Batista era came to an end in 1959 after a successful 3-year guerrilla campaign led by a young lawyer named Fidel Castro. Once Castro seized power, he proceeded to reform the country’s economy by confiscating US investments in banks and industries and nationalising all landholdings larger than 400 hectares. This nationalisation and confiscation of US properties and businesses triggered an immediate deterioration of US-Cuba relations. Key international and domestic events following the 1959 revolution have contributed to Cuba's current political and economic situation (Table 1.1).

Table 1.1 **Key historical events** (adapted from Destination Cuba, 24 Jan. 2000; the World Factbook 2000, 10 Jan. 2001; Fried 1999)

1959 - Castro becomes president of Cuba. Triggers a break in US relations and forms an alliance with the Soviet Union.

1960 - US responds by imposing a trade embargo.

1961 - Bay of Pigs: 1,400 CIA trained Cuban exiles invade Cuba, landing at the Bay of Pigs. The invasion led to a complete brake in diplomatic relations between the two countries.

1962 - US discovers Soviet-supplied missile installations in Cuba. President Kennedy orders a naval blockade. After negotiations with Soviet Premier Khrushchev the weapons are removed from Cuba.

1989 -Collapse of the Soviet Union, all Soviet-bloc aid and trade subsidies to Cuba are terminated and the "Special Period" commences.

1992 -The United States passes the Torricelli Bill, also known as the Cuban Democracy Act, extending the US trade embargo to overseas subsidiaries of American firms.

1993 - Cuba decriminalises ownership of US dollars and allows self-employment in 100 trades and businesses including farmer's markets.

1996 - Claiming a violation of airspace, Cuban jet fighters shoot down two civilian planes owned by the "Brothers of the Rescue" an US based group headed by Cuban exiles. Cuba claimed that they had violated their airspace. In retaliation the US Congress passes the Helms-Burton Act in an attempt to further prevent their foreign trading partners from investing in Cuba.

The Special Period

In 1989, Cuba's economy collapsed as a result of the demise of its main trading partner, the Soviet Union. Consequently Cuba lost 75% of its imports including food and agricultural inputs (Altieri *et al.* 1999). It is estimated that before 1990, Cuba was importing up to 57% of its caloric intake and 99% of its oil imports from the Soviet Block (Chaplowe 1998). Cuba plunged into its worst economic crisis; labelled as the "Special Period in Time of Peace" (commonly referred to as the Special Period). This term was coined as a result of the special measures taken during this state emergency, measures that are normally limited to wartime. Examples include the use of bicycles for mass transportation and the use of animals in the place of tractors (Murphy 1999).

The passing of the “US Cuban democracy Act” in 1992 (by the US Congress), exacerbated this economic situation by extending the US trade embargo to overseas subsidiaries of US firms (Chaplowe 1998). In 1996, the “Cuba Liberty and Democratic Solidarity Act” or “Helms-Burton Act” further tightened the trade embargo by deterring foreign investment (Warwick 1999).

Prior to 1989, Cuban agriculture was based on large-scale, chemical-intensive monoculture that was highly mechanised and therefore depended on a plethora of agricultural imports (Rosset and Benjamin 1994 p. 3). After 1989, pesticide imports dropped by 60%, fertiliser imports by 77% and petroleum imports dropped by 53% (Rosset and Benjamin 1994 p.3-4). This dependence agricultural imports seriously threatened Cuban food security, and in response the Cubans began to transform their conventional agriculture by adopting an alternative model based on the Low Input Sustainable Agriculture paradigm also known as LISA. This model draws on agroecological principles and promotes sustainable production by replacing machinery and chemical inputs with animal traction, crop and pasture rotations, soil conservation, and biological control organic fertilisers (Rosset and Benjamin 1994 p. 5).

Urban agriculture

Another alternative strategy adopted by Cuba, has been the establishment of urban agriculture on a national scale. Urban agriculture encompasses the production of food and non-food plants, tree crops, and animal husbandry (livestock, fowl, fish) both within and fringing urban areas (Mougeot 1994). Before 1989, urban agriculture was virtually non-existent in Cuba, as gardening was perceived by many as a sign of underdevelopment and poverty (Altieri *et al.* 1999, Chaplowe 1998). When the Special Period exposed Cuba’s heavy dependence on food exports and threatened food security, out of necessity an abundance of gardens began to spring up all over Cuba.

The urban gardens are reported to use minimal external inputs and apply principles of agroecology and organic agriculture (Altieri *et al.* 1999) (Table 1-2). Their success is attributed to their reliance on local resources and their utilisation of integrated pest management and organic soil management.

Table 1.2 Fundamental elements of Cuban urban agriculture
(after Altieri *et al.* 1999; Socorro 1999)

♦ Soil management	-Utilise organic matter from farm and industrial sugarcane residues -Produce humus from organic matter -Apply biofertilisers such as *Azotobacter, Rhizobium* -Cultivate green manures particularly nitrogen-fixing legumes
♦ Water management	-Monitor the quality of the irrigation water especially for its salinity -Irrigate appropriately depending on the season (in critical periods the frequency depends on the yields)
♦ Crops and varieties	-Use both local and hybrid seeds to maintain diversity -Plant crops according to season and utilise appropriate planting distances -Use varieties of plants that are resistant to pests and diseases -Produce seeds locally, grow seedlings in local nurseries
♦ Pest management	-Practice crop rotations and inter-cropping year around -Utilise biological control in the form of entomopathogens, bacteria, fungi, beneficial insects and antagonists -Plant and apply botanical pesticides such as Neem and *Tabaquina* -Set out pheromone traps and trap crops to divert insect pests
♦ Economic aspects of production	-Practice intensive exploitation, and animal integration where possible -Plan production and marketing strategies -Wise use of local resources
♦ Capacity building	-Provide training to urban farmers -Support from the government in the form of extensionist programs, seed houses and the general support that comes from the agricultural enterprises and co-operatives

Organoponicos

Several types of urban food production systems were established during the Special Period including self-provisioning gardens (*autoconsumos*), household gardens, intensive gardens, and *organoponicos* (Table 1.3). *Organoponicos* are urban gardens where cultivation takes place in container beds (*canteros*) filled with a mix of organic matter and soil. The containers are usually concrete but in some cases stones, wood, asbestos and metal have been used (Murphy 1999). The term *organoponico* is an adaptation of the term hydroponics, which is a form of agriculture where food is grown in an inert medium (sand, gravel) that is fed liquid nutrients (Socorro 1999).

Table 1.3 Types of urban gardens in Cuba
(after Altieri *et al* 1999; Socorro 1999)

♦ *Organoponicos*	-Located in residential areas or areas close to markets with poor soil quality -Intensive cultivation occurs in containers beds under organic techniques and sustainable crop management
♦ Intensive gardens (*Huertos Internsivos*)	-Same as *organoponicos* but in this case the gardens are located in areas with high quality soils and thus crops are planted directly into the soil (in raised beds)
♦ Hydroponics & Zeoponics	-Plants cultivated indoors or outdoors in a nutrient rich solution, which is run in an inert planting medium such as zeolite -This method utilises inorganic fertilisers
♦ Suburban farms	-Small farms located in peri-urban areas -Animal production is usually integrated and these units tend to be larger than 2 ha. This is a mixed system that relies on local inputs and strives to minimise synthetic inputs
♦ Popular gardens (*Huertos populares*)	-Located in marginal urban areas such as vacant lots, reclaimed dumps and old parking lots. -Managed by local community organisations
♦ Self-provisioning (*Autoconsumos*)	-Located on or near the property owned by factories and enterprises. -Most of the food produced is used to feed the workers and their families
♦ Household gardens (*Patios y parcelas*)	-Located in people's backyards, rooftops, balconies and any other private space available

In *organoponicos,* the organic matter is usually transported to the city from rural farm areas and added to the container beds. This practice has been adopted because the poor quality urban topsoil renders it unsuitable for agriculture; it is often contaminated with garbage, glass and other foreign materials (Altieri *et al.* 1999). *Organoponicos* are the most popular type of urban garden because of the general poor soil quality within urban areas. According to Altieri *et al.* (1999), the total number of *organoponicos* in Cuba in 1996 was 1,613 covering an area of 250 hectares. The primary crops cultivated in *organoponicos* are vegetables, medicinal plants and condiments (Socorro 1999). The term *organoponico* not only suggests that the substrate in which plants are grown is composed of organic matter, but also implies that the techniques practised are compatible with organic agriculture (Socorro 1999).

Organic agriculture

The term 'organic agriculture' has been at the centre of debate for some time (Nolte and Werner 1999; Merrill 1983). There exist a number of definitions that generally fall into three categories: those that focus on the prohibited inputs of organic food production, processing and distribution. Those that focus on the products and practices that replace the prohibited inputs and practices and those that emphasise the agroecosystem and design of the farm with the goal of producing superior quality food by working in harmony with ecological processes (MacRae *et al*. 1989). In many cases when reference is made to organic agriculture it still is not clear which definition is being used.

The Canadian General Standards Board defines organic agriculture as " a holistic system of production designed to optimise the productivity and fitness of diverse communities within the agroecosystem, including soil organisms, plants, livestock and people. The principle goal of organic agriculture is to develop productive enterprises that are sustainable and harmonious with the environment" (CGSB 1999 pg. iii). Some of the general objectives of organic agriculture are to minimise soil erosion, improve water quality, enhance biological diversity and recycle materials and resources within the enterprise (CGSB 1999).

In North America, organic agriculture has existed on a small scale ever since the early 1940s (MacRae *et al*. 1989). In Europe, organic production appeared in 1924 with Rudolf Steiner's course on bio-dynamic farming and in the 1960s many farms began to convert to organic management. In more recent years, organic foods have been integrated into the mainstream food industry, leading to an increase in organic food production on a global scale. In Canada there is 1 million hectares of agricultural land under organic management (Willer and Yussefi 2000). Many other countries in the world have begun converting to organic production in response to the increased demand for organic foods in Europe, North America and Japan. It was estimated that the market for organic foods would reach 20 billion dollars in the year 2000 (Willer and Yussefi 2000). According to a study conducted by the International Trade Centre (ITC), trade in organic foods has become a major business and it is predicted that annual growth rates will range from 5% to 40%

over the medium term. Furthermore, global organic food sales are expected to jump from 1% to 10% of total retail food sales in the next few years (ITC 1999).

Rationale of organic certification

In response to the increased demand for organic foods, the organic food industry worldwide has taken steps to develop credible organic certification programs. Organic certification programs have existed since the late 1970s and were developed based on the principles of agroecology and on the guidelines of two international organisations, the Organic Foods Production Association (OFPANA) and the International Federation of Organic Agriculture Movements (IFOAM) (MacRae *et al.* 1989).

Demand for certification arose from the need to adequately describe an environmentally conscious production system and to assure consumers that organic producers were complying with strict quality guidelines (MacRae *et al.* 1989). Enforcement of organic standards is particularly important to consumers who usually pay more for organic produce than they would for conventional foods on the premise that such food is safer and "environmentally friendly" (Sullivan 1997).

Organic certification is the process by which an independent party provides written assurance that an organic product conforms to specific requirements or standards (CGSB 1999). According to the Organic Crop Improvement Association (OCIA 2000), organic certification is a system of institutionalised trust that allows consumers to identify and reward good stewards of our natural heritage. To ensure the integrity of the term "organic", certification agencies or bodies have developed specific standards for production and processing. The certification bodies have established verification procedures that include farm inspections, paper audit trails and reviews of applications by a certification committee (MacRae *et al.* 1989).

Organic standards are a set of voluntary guidelines that producers must conform to have their products labelled as organic. The standards define organic agriculture by outlining the principles of crop and livestock production, periods of conversion, production planning and record keeping, storage, transportation and processing. In 1999, Canada released the National Standard for Organic Agriculture that specifies the minimum criteria that must be met when food products used and produced in organic agriculture are defined as organic (CGSB 1999). The driving forces for establishing a national standard have been the globalisation of the organic industry. By establishing the National Standard, Canada is attempting to create an infrastructure that facilitates international trade in organic foodstuffs (COG 2001).

Although organic agriculture is practised in almost all countries of the world, there is a general lack of state regulations that makes it difficult in many countries to distinguish organic from low-chemical or even non-organic products (Willer and Yussefi 2000). According to Willer and Yuseffi (2000), almost all Latin American countries have an organic sector but lack a quality control mechanism in national legislative or regulatory frameworks. However, in most of these countries local inspection and certification bodies have been established.

In the last few years, Cuba has gained extensive publicity about its organic movement. Although Cuba is being praised for its organic practices (Altieri *et al*. 1999; Murphy 1999; Warwick 1999; Rosset and Benjamin 1994), it is unclear how "organic" this movement is. To date there is no certification process in place in Cuba although there is a group that is developing standards for Cuban organic agriculture (Morin 1998; Holtslander 2000). The global movement towards the development of organic agriculture appears to stem from a desire to tap into a promising world market. However, Cuba's shift to organic agriculture arose out of necessity.

The Cuban diet

Cuban food is not spicy; very few condiments are used and these are primarily limited to cumin, peppers, parsley, garlic, onions and cilantro. Compared to the diets of other Caribbean countries, the Cuban diet is monotonous and people have been known to complain about the lack of variety (Benjamin *et al.* 1986 pg. 107). One factor that is likely exacerbating the lack of diversity is the fact that Cubans are quite particular about what they eat. According to Perez and Munoz (in Rosset and Benjamin 1994 pg. 23), food surveys in Cuba have consistently shown that what Cubans want on a daily basis, for both lunch and dinner is rice, beans, some type of meat preferably pork, *viandas* (such as plantain, cassava, potatoes or sweet potato), and bread. The favourite fruits of Cubans are mango, guava, avocado, plantains, citrus, and papaya. The preferred mode of consumption is through "*batido*"; a fruit shake made with ice water, powdered milk and considerable amounts of sugar.

A popular saying in Cuba demonstrates the significant place rice holds in the Cuban diet, "sin arroz no hay comida" (without rice there is no meal). Rice has to be the most important staple in the Cuban diet in that if no rice has bee eaten during the day, people do not feel like they have had a proper meal.

The Cuban diet and the Special Period

Prior to the Special Period, the Cuban diet was not particularly healthy. It was high in total calories, fat, and carbohydrates, adequate in protein, low in fibre and adequate in vitamins and minerals (Benjamin *et al*. 1986 p. 107). Cubans did not consume many vegetables as they were perceived to be "rabbit food".

To make the country more self-sufficient, the government had to do something about changing the production and consumption patterns of the Cuban people. In 1989, the government launched the National Food Program (*Programa Alimentario*) that was designed to support the country through its transition from dependency on the former Soviet Union. One of the main objectives of the program was to increase the production of *viandas* and vegetables (Deere 1993). The rationale was to substitute *viandas* for rice and wheat and vegetables for animal protein (Rosset and Benjamin 1994 pg. 25). Prior to the Special Period the government treated *vianda* crops as secondary hence they were not cultivated on state farms. Their cultivation was limited to small farmers and co-operatives. Nevertheless there is evidence to suggest that *viandas* have always been essential to the Cuban diet and that demand always exceeded the supply (Rosset and Benjamin 1994 pg. 25). However, nothing was done to address this issue until the government was forced to by circumstances.

In an effort to replace the loss of meat, the government introduced a new line of soya-based products and made several changes to the ration system (Premat 1998). Products such as soya yoghurt and milk began appearing along with various food surrogates that were meant to replace chicken and pork. Faced with all the food shortages, the government began to slowly distance itself from its active role in food distribution and sales. The food shortages were so critical that in 1991, milk was available only through the ration and cheese, butter and yoghurt became non-existent (Rosset and Banjamin 1994 pg.24).

Following the launch of the National Food Program, urban agriculture was introduced as an alternative source of food security. The shift in diet was made possible through the establishment of urban gardens in every municipality across Cuba. In 1997, urban agriculture in Cuba produced 160,000 tons of food of which 47,651 tons were produced in *organoponicos* (Novo and Murphy 1999).

Dietary contributions of gardening

Small domestic vegetable gardens in developing countries have been praised for their significant nutritional contributions, especially with respect to vitamin A requirements (Vijayaraghavan *et al*. 1997; Bloem *et al*.; 1996; Pacey 1978). In India, nutritionists estimate that for vitamin needs to be met, individuals should consume 235 g of vegetables daily of which 100 g should be leafy greens (Pacey 1978). Dark leafy green vegetables, carrots, sweet peppers and some tomatoes are rich in carotene or pro-vitamin A, while many green vegetables also provide vitamin C, iron and calcium (Pacey 1978).

Current reports indicate that the Cuban urban gardens have now increased the availability and consumption of fresh vegetables in urban areas thereby improving the quality of the diet (Murphy 1999).

CHAPTER 2
METHODOLOGY

In this chapter, the methodology used to conduct the study is described along with some of its limitations.

2.1 Operation and certification status of *organoponicos*

To gain an understanding of how the *organoponicos* operate and to assess their organic status, one system was studied in detail while complementary information was collected from 10 other *organoponicos*. Between October 1 and December 30, 1999, I worked with the gardeners of the La Calsada *organoponico* assisting in cultivation, interviewing personnel and conducting measurements. "Participatory observation" was conducted through casual conversations, informal and unstructured interviews (Bernard 1995). Information was collected concerning the production methods and inputs and outputs of the system. Questions were focused on pest management, cultivation methods, marketing and the general operation of the garden. Through casual conversations and participatory observations, approximate quantities of inputs and outputs such as compost, water, labour and produce were documented.

A soil test was conducted to reveal possible heavy metal excesses in the system. There was concern that the soil may be contaminated due to the proximity of the garden to a heavily used road. Soil samples were taken from each of five randomly chosen canteros in the *organoponico.* Each sampled bed was 33 metres long, 1.2 metres wide and 0.4 metres deep. Samples were taken along the length of the container bed with a trowel, deposited and mixed in a bucket. From this mix, a sub sample of approximately 250 g was collected. These samples were dried, transferred to Canada and analysed at Philip Analytical in Halifax, Nova Scotia for heavy metal content (method 3050B-Phillip Analytical 1996) (Table 2.1).

Table 2.1 List of heavy metals screened in soil samples

Aluminium	Cadmium	Lead	Silver
Antimony	Chromium	Manganese	Strontium
Arsenic	Cobalt	Molybdenum	Thallium
Barium	Copper	Nickel	Vanadium
Beryllium	Iron	Selenium	Zinc
Boron			

Structured interviews with garden managers

A letter of consent was prepared in Canada in accordance to the requirements of Dalhousie University's Human Ethics Review Board. However, individuals were not asked to sign the form because suspicion may have been aroused where none was due. Instead, all the information contained in the consent letter was disclosed to participants and verbal permission was obtained before proceeding with the interviews.

The manager of the La Calsada *organoponico* was interviewed on October 27, 1999. The managers of ten other *organoponicos* in the municipality of Cienfuegos were interviewed between November 18 and 27, 1999. The *organoponicos* were selected with the help of the Mixed Crop Enterprise (Enterprise), a state-owned enterprise that oversees production in these semi-private operations. These sites were strongly recommended by the officials of the Enterprise as typical operations for the *organoponico* system who indicated they are among the best urban gardens in Cienfuegos. Each interview consisted of two questionnaires. The first questionnaire was created by Dr. Alejandro Socorro for his own research, and was used with his permission in this study (see Appendix B). A second questionnaire was created based on the application forms for organic certification by the Nova Scotia Organic Growers Association[2]. The interviews were tape-recorded and the information was subsequently transcribed into Spanish and translated to English.

[2] Nova Scotia Organic Growers Association: http://gks.com/NSOGA/index.php3#steps

Informal interviews with the agricultural extensionists

Informal interviews were conducted with agricultural extensionists working for the Enterprise in Cienfuegos to gain a sense of how the Enterprise oversees production in the *organoponicos*. Questions were asked about the role of the Enterprise and more specifically of the role of the extension officers[3] in the *organoponico* production. Questions focused on pest management, soil management, crop rotations, crop varieties and other amendments and inputs that are used in production. Furthermore, information was gathered during attendance at two general meetings of the urban producers in the municipality of Cienfuegos. Finally, literature was obtained from the agricultural extensionists on the cultivation techniques used in *organoponicos.*

Organic certification standards

To examine the degree to which *organoponicos* in Cienfuegos are “organic” the “La Calsada” *organoponico* was studied in detail, described and assessed along with supplementary information obtained from 10 other *organoponicos.* The Canadian National Organic Standards (1999), section 5 (Organic Production Plan and Records), section 6 (Crop Production) and Appendix A (Permitted Substances List for Crop production) were used to assess compliance of the *organoponicos* to related standards.

Nutrient limitation experiment

A nutrient limitation experiment was conducted to determine whether any major nutrients (nitrogen, phosphorus and potassium) are limiting. Lettuce (*Lactuca sativa*) was selected as the experimental crop because it was one of the main crops in season and has a relatively short production cycle. The nutrient limitation experiment was conducted in a container bed (internal dimensions of 15 m long by 1 m wide and 40 cm in height) at the *organoponico* of La Calsada between October 1 and December 4, 1999. Three treatments were applied: control (no additions), nitrogen, phosphorus and potassium (9-2-5) fertiliser (hereafter known as mixed treatment) and potassium sulphate fertiliser (hereafter referred to

[3] Extension officers work for the Mixed Crop Enterprise and provide farming advice to the urban cultivators.

as potassium treatment)

The mixed fertiliser was a 9-2-5 organic fertiliser produced by Ecoval (Montreal, Canada), applied at 83.3 g m^{-2}(75 kg N ha^{-1}). The potassium fertiliser was potassium sulphate, applied at 15 g m^{-2} (75 kg K_2O ha^{-1}). Plots were set out in a Randomised Complete Block design (Lyman 1988) with 4 replicate blocks. Plots were 1 meter in length by 1 meter wide, set out linearly with a 20-25 cm barrier zone between each successive plot. On October 2, 1999, the bed was prepared for cultivation in the typical manner of *organoponico* production. Specifically, the soil of the beds was turned over and allowed to bathe in the sun during the day (to rid it of nematodes) after which the soil was smoothed back into place and combed using a piece of wood. During the evening, the bed was planted with 25-day old lettuce seedlings. The lettuce was transplanted in the square planting method applied by the Cubans. The corners of the square are approximately the distance between the thumb and index fingers and the lettuce is planted in each of the four corners.

On October 8, 1999, the plots were set up and the treatments were applied to the plots by mixing the fertilisers into the soil between the lettuce plants. On November 4, 1999, all the lettuce plants were harvested, counted and the fresh weight was recorded. Leaf samples were taken from the central 75 cm of each plot. Two to three leaves were harvested from each plant per plot and combined for each treatment. The leaves were dried in a solar box. On the same date, soil samples were collected from each treatment with a trowel, deposited and mixed in a bucket from which a sub-sample of approximately 250 g of the mix was collected. Both the leaves and soil samples were transferred to Canada by plane and analysed for nutrient (nitrogen, phosphorus, potassium) content at the Harlow Institute, Truro, Nova Scotia (Gavlak *et al.* 1984).

On November 6, 1999, the container bed was re-planted in the same manner with the same variety of lettuce seedlings (20-25 days old). Fertiliser was not reapplied but lettuce was planted in the same container to test the residual effects of the fertilisers.

On December 4, 1999, the plants were harvested, counted and the fresh weight was recorded. Leaf samples were collected in the same manner as above and analysed at the Experimental Station of Escambray in Cienfuegos Province, Cuba.

An analysis of variance was conducted using SUPERANOVA (Abacus Concepts). In the first experiment since the plots were laid out after the lettuce had already been planted, the number of plants varied among the plots. To overcome this source of error the residuals from the regression on plant density (r^2=0.319) were used in the ANOVA. In the second experiment no adjustment was necessary because the number of plants per plot was constant.

2.2 Dietary role of the *organoponicos*

Structured survey interviews with garden customers

A questionnaire to determine people's diets and consumption of vegetables (Appendix C) was created with the help of Juan Chaviano, a nutritionist working for the Provincial Health Centre in Cienfuegos. Between December 20 and December 27, 1999, forty-one randomly chosen customers of the La Calsada *organoponico* were surveyed in person during the hours that vegetables were being sold from the garden. I asked every other person that approached the kiosk in search of food whether they would be interested in participating. A short survey that could be answered rapidly was used as many of the persons looking for food in the garden were in a hurry to get home. The questionnaire was composed primarily of yes and no answers and included some questions regarding socio-demographic characteristics.

In the questionnaire, the food groups were broken into the following categories: milk, meat (pork, chicken, luncheon meats and beef), fish, eggs, rice, beans, oils (vegetable oils and lard), *viandas* (tuber crops as well as plantain), fruits and vegetables. The frequency by which people consumed foods was divided into four categories: daily, weekly, monthly and less than once a month. Weekly consumption was defined as eating the food item at least once a week and less than 7 days a week. If an item was consumed bi-weekly it was placed under the monthly category, and if a food item was consumed infrequently for periods longer than a month it was placed under the less than once a month category.

Through participatory observations and unstructured and semi-structured interviews, three workers of the organoponico were also questioned about their diets and their views concerning the contribution the gardens have made to their diets.

Statistical Analyses

The data obtained from the dietary survey was analysed using Chi-squares, Z-tests, and Coefficient-Intervals (Lyman 1988). Chi-squares tests of independence were conducted to determine whether a relationship exists between the types of food consumed and the age and family size of participants. Hypotheses were formulated for the Chi-squares tests of independence:

Chi-Square test of independence
food consumption and family size and age of interviewees

1-1. Ho: family size and daily food consumption are independent

1-2. Ho: family size and weekly food consumption are independent

1-3. Ho: ages of interviewees and daily food consumption are independent

1-4. Ho: ages of interviewees and weekly food consumption are independent

Alternative hypothesis: Ha: the two variables are dependent

A chi-square test of independence was not conducted for food consumed on a monthly basis due to insufficient data. The expected values for monthly consumption were below 1 and the test was not valid. A Chi-square test of independence was also conducted to examine potential relationships between vegetable preference and consumption, and age and family size of participants,

Chi-square test of independence
vegetable preference and consumption and age and family size of the interviewees

2-1.Ho: family size and vegetable preference are independent

2-2.Ho: family size and vegetable consumption are independent

2-3.Ho: ages of interviewees and vegetable preference are independent

2-4 Ho: ages of interviewees and vegetable consumption are independent

Alternative hypothesis - Ha: the two variables are dependent

Age among the interviewees was divided into the following cohorts: younger than 30, between 30-40, between 40-50 and 60 or older. The family sizes were categorised as consisting of one, two, three, four, five and six or more members. In all cases, some of the variables were removed due to insufficient data points that resulted in expected values lower than 1 thereby rendering the test invalid. For the Chi-square test of independence involving vegetable preference and age the following variables were removed from the tests due to insufficient data:

Test 1-1:	meat and fish
Test 1-2:	rice
Test 1-3:	meat and fish
Test 1-4:	rice and beans

For test 1-2 the family sizes were combined and reduced to three categories those of families ranging from 2-3 members, 3-4 and 5 or more members.

For the Chi-square test of independence involving vegetable preference and consumption the following variables were removed from the tests due to insufficient data:

Test 2-1:	spinach and eggplant
Test 2-2:	eggplant, spinach and parsley
Test 2-3:	spinach
Test 2-4:	spinach, parsley and eggplant

Z-tests were conducted to compare the proportion of participants consuming vegetables in relation to the other food groups.

The following null hypotheses were tested:

(1) Ho: proportion of people eating vegetables daily equals the proportion of people eating meat daily

Ha: proportion of people eating vegetables daily exceeds the proportion of people eating meat daily

(2) Ho: the proportion of people consuming vegetables daily equals the proportion of people consuming fruits daily

Ha: the proportion of people consuming vegetables daily exceeds the proportion of people consuming fruits

(3) Ho: the proportion of people consuming vegetables daily equals the proportion of people consuming tubers

Ha: the number of people consuming tubers on a daily basis exceeds the number of people consuming vegetables on a daily basis

(4) Ho: the proportion of people consuming vegetables on a daily basis equals the proportion of people consuming vegetables weekly

Ha: the proportion of people consuming vegetables daily exceeds the proportion of people consuming vegetables weekly

Confidence Intervals

The questions (1-5) on page 2 of the questionnaire (Appendix C) were analysed using confidence intervals to determine the range of values within which μ is likely to be found. Within a 95% confidence interval there is a 95% chance that the actual value of μ is likely to be found.

Semi-structured interviews with nutrition experts

Three semi-structured interviews were conducted with individuals considered to possess expertise in nutrition: a well-known physician, a nutritionist and a clinical researcher.

Initially the clinical researcher was identified as a key informant and the other two were selected through the "snowball" method[4] (Bernard 1995). The goal was to gain a general sense of Cuban dietary preferences and deficiencies and the contribution that *organoponicos* have made to the Cuban diet.

2.3 Limitations of the research

One of the limitations to this research is my lack of fluency in Spanish. When I arrived in Cuba, my Spanish was not very good and so I dedicated the whole month of September studying the language. In addition, I tape recorded all of the interviews and hired a Cuban to transcribe them.

Another limitation was the narrow and small size of the sample, which makes generalisations about the entire population of Cienfuegos risky. I am confident that the sample size of the *organoponicos* was sufficient considering the Enterprise recommended these gardens as the best examples of the *organoponico* system in Cienfuegos. On the other hand, for the study of the dietary role, interviewees were for the most part limited to cultivators and patrons of the case study garden.

[4] Through this method a key informant is identified, someone knowledgeable who names other people with knowledge on the topic of interest.

CHAPTER 3

OPERATION AND CERTIFICATION STATUS OF *ORGANOPONICOS*

One representative *organoponico,* La Calsada, was studied in detail and will be presented as a case study. However, formal and informal interviews were conducted with the managers of 11 gardens (including La Calsada's) and agricultural extensionists to determine the organic status of the *organoponicos* in the city Cienfuegos located in the province of Cienfuegos. All of the *organoponicos* examined in this research are overseen by a state-owned enterprise (Empresa de Cultivos Varios Agropecuarios), hereafter referred to as the Enterprise. Out of those 11 gardens, only one was engaged in livestock production, therefore the research focused on the elements of crop production. The description of the case study garden follows the format typical of a third party certification agent's report (where applicable). The certification agent's report is part of the organic certification process (Appendix D). In the following section additional information is presented relating to the general operation of *organoponicos.*

3.1 Administration of *organoponicos* in Cienfuegos

There are a total of 102 organoponicos operating in the municipality of Cienfuegos (see table 3.1). Within city limits there are 81 *organoponicos* located in the neighbourhoods of: Paraíso, Buena Vista, Tulipán, La Juanita, San Lázaro, Pueblo Grifo, Pastorita, Reina, Punta Gorda, Junco Sur and Caonao. The city of Cienfuegos (from the perspective of *organoponico* production) has been divided into four districts: north, south, Cao Nao and the airport.

In the city of Cienfuegos there are two types of *organoponicos*, state run and semi-private operations. The land where both forms of operations are located belongs to the state but they differ in management and purpose. The state-operated gardens are usually associated with the dining room of a factory, enterprise, or institution. The food produced in these gardens is not sold to the public rather it is used to supply the cafeterias of institutions or factories. In Cuba people receive free lunch at work thus many of the gardens are supplying the food for these meals. On the other hand the semi-private *organoponicos* usually sell 95% of their produce directly to the public and 5% to a nearby day care or school and the cultivators keep the profits.

Table 3.1 *Organoponicos* pertaining to the municipality of Cienfuegos

Neighbourhoods	Number of *organoponicos*	Total area (ha)
Paraiso	21	3.78
Rancho Luna	4	0.27
Buena Vista-Tulipan	9	2.12
Castillo de Jagua	7	0.67
La Juanita	5	0.26
San Lazaro	7	0.66
Pueblo Grifo- Pastorita	21	2.38
Reina	1	0.02
Punta Gorda	6	0.44
Junco Sur	6	1.20
Guaos	1	0.33
Caonao	5	3.10
Pepito Tey	2	0.77
Others	7	3.50
Total	102	19.50

The Enterprise overlooks the production in at least 63 of the gardens while the remainder of the *organoponicos* are operated by the state. In the semi-private *organoponicos* there are 118 registered cultivators of whom only 13 are women. There are approximately 210 registered cultivators working in the municipality. This number does not take into account the persons who are working unofficially in the gardens. The methods of cultivation in both types of *organoponicos* are similar, the biggest difference being that the gardeners of the state-run operations receive a monthly salary whereas the cultivators of the semi-private operations share in the profits.

The land where the semi-private *organoponicos* are located is rented through the Enterprise. Gardeners pay 5 pesos[5] or 25 cents USD per square meter per year. They also pay for water, electricity, social security insurance, biological controls, seeds, organic matter and any other inputs used in production. The Enterprise supplies inputs such as seeds, organic matter, biological control products and tools to the gardeners. On a monthly basis, after payments of rent, base salaries and other expenditures, the profits from produce sales are evenly distributed among the cultivators.

Each garden is assigned a general manager who, apart from cultivating, also

[5] In 1999, the exchange rate was 21 pesos for $1 US dollar.

oversees all production and logistical aspects of the operation. They are referred to as *jeffes* or bosses. On average, cultivators in semi-private operations are making 500 pesos a month assuming production runs smoothly. The *jeffes* are making 10-20% more. In the semi-private operations most gardeners started out by receiving a fixed salary from the Enterprise but as they gained experience and the gardens grew profitable they opted for self-employment. For example, in one of the gardens the workers were initially receiving salaries of 174 pesos a month while the *jeffe* was receiving 210 pesos a month. They have since maintained the salaries as a base payment, but now once all their bills are paid, whatever is left over (minus the salaries) is divided equally among all the workers, including the *jeffes*.

For each district the Enterprise has assigned an agricultural extensionist who visits the gardens on a weekly basis and provides expert advice while reporting back on the progress of each operation. Many of the workers have limited experience in agriculture and depend on this assistance. The extensionists help identify various diseases and pests while making recommendations for appropriate treatments and improved cultivation techniques. They provide advice on inter-cropping, weeding, crop rotations, planting distances, crop varieties, water management and other production issues. Furthermore, the Enterprise is responsible for conducting water and soil analyses.

As was mentioned previously, the majority of the urban gardeners had little experience before they embarked in their agricultural careers. To address this issue the government sponsored numerous workshops and seminars to educate people in farming practices. The Enterprise continues to organise 3 annual workshops. In 1999, the themes of the workshops were plant health, cultivation techniques and seed production. Cultivators from both semi-private and state-run operations are invited to attend these courses.

Every two weeks, the cultivators of the semi-private operations of each district, the extensionist, the sub-director of the Enterprise and the director of the plant health division convene and discuss the progress and problems of the *organoponicos*. The extensionist usually reports his/her observations made during the rounds and makes related recommendations based on established regulations. The Enterprise has a number of these regulations and the managers of the *organoponicos* are expected to follow them. For example, the Enterprise encourages all the gardens to have at least 15 different crops at any time in the garden, to follow crop rotations, to inter-crop, to use compost and worm humus as soil amendments, to use biological control and minimise the use of chemicals. Every 3 months, all of the gardeners from the districts in the municipality have a meeting where concerns are expressed and solutions are discussed.

The Cuban government provides various incentives to encourage compliance with production regulations in the urban gardens. For example, the Enterprise sends an extensionist to conduct a monthly evaluation of the *organoponicos* and awards the managers of the gardens that have performed well (see table 3.2). The *organoponico* that has performed the best in the municipality during the year receives a nationally recognised award.

Table 3.2 Evaluation criteria for the Enterprise *organoponicos* awards

Criteria	Points
Fulfilment of the production plan	25
Proper cultivation	25
• Cultivation of a minimum of 15 crops	
• Cultivation of all the container beds	
• Practice of correct crop rotation	
• Practice of inter-cropping	
• The garden is pest and disease free	
Successful weed control	10
Obtention of planned yields	10
• 24 kg/m^2 per year or 2 kg/m^2	
Soil fertility practices	10
• Production of worm humus	
• Production of compost	
• Application of organic matter	
Evidence of national symbols in the garden	10
• Colours of the beds (blue/red)	
• Colours of the kiosk and fence (red)	
• Vegetable signs	
• Cuban flag	
• Paintings with revolutionary content	
Production of seed	10
• 12 kg per year or 6 kg per 6 months	
Total	**100**

Evaluation:	**Good:**	85-100
	Satisfactory:	70-85
	Poor:	less than 70

3.2 Operation of the *organoponicos*

The mandate of the *organoponicos* is to provide fresh, healthy and affordable food to the Cuban people. The gardens generally operate six days a week with Sunday being a day of rest (Table 3.3). The daily hours of work vary. However, most gardeners begin work around 6 or 7 a.m.; they break at noon for lunch and start work again after 3 p.m. (it is too hot to begin before that) ending the day at around 6 p.m.

Table 3.3 Common characteristics of the 11 *organoponicos* selected for this study

♦ Ownership	-The land is owned by the state and is rented out at 5 Cuban pesos per

	square meter per year. All 11 *organoponicos* are semi-private operations.
♦ Extensionist Services	-The Enterprise sends an agricultural extensionist weekly to offer guidance and advice to the cultivators. -The Territorial Station for the Protection of Plants assigns a pest and disease expert to 5 gardens that are visited bi-weekly.
♦ Construction	-Most gardening takes place in concrete container beds. -The beds are filled with a gravel, soil and organic matter mix. -All gardens are entirely fenced except one.
♦ Hours of operation	-All gardens operate 6 days a week with Sunday being a day of rest. The daily hours of operation vary depending on the garden.
♦ Cultivation organic	-Cultivation in all 11 *organoponicos* is based on principles of agriculture such as crop rotations, intercropping, use of natural fertilisers and biological pest control, however, some synthetic chemicals are used occasionally. -Genetically Modified Organisms[6] are not used.

In the *organoponicos* observed, cultivation takes place in horizontal cement container beds that have earthen floors. The Enterprise recommends that the beds be oriented north to south. The dimensions of the beds vary but typically they are about 30 meters long and 1.2 meters wide. The depth of the container is approximately 0.4 meters while the passages between the beds are about 0.5 meters. These dimensions were designed to make it easy for people to cultivate the beds. In most cases, the gardeners sit along the ledges of the containers while planting.

The *canteros* are filled with a layer of gravel (for drainage) topped by a mixture of soil and organic matter. It is recommended that the substrate be at least 50% organic matter. In some cases, gardeners had a 1:1:1 ratio of soil, organic matter and zeolite (minerals of aluminium silicate), while in others gardeners stated that the beds contained more than 90% organic matter. The *organoponicos* are dedicated to vegetable production (table 3.4). The most popular crops are lettuce (dry season) and string beans (rainy season).

[6] According to the Independent Organic Inspectors Association (1998), GMOs are made with technology that transforms the molecular or cell biology of an organism by means that are not possible under natural conditions or processes. Genetic engineering includes cell fusion, gene transfer, introduction of new genes, recombinant DNA, micro- and macro-encapsulation, gene deletion and doubling.

Table 3.4 Most common crops cultivated

Crop	Spanish name	Latin name
Beets	Remolacha	*Beta vulgaris*
Cabbage	Col	*Brassica oleracea*
Carrots	Zanahoria	*Daucus carota*
Celery	Apio	*Apium gravolens*
Chard	Acelga	*Beta vulgaris*
Chives	Ajo-puerro	*Allium schoenoprasum*
Cilantro	Cilantro	*Coriandrum sativum*
Cucumber	Pepino	*Cucumis sativus*
Eggplant	Berenjena	*Solanum melongena*
String bean	Habichuela	*Phaseolus vulgaris*
Lettuce	Lechuga	*Lactuca sativa*
Okra	Quingbobo	*Hibiscus esculentus*
Green	Cebollino	*Allium cepa*
Onions	Perejil	*Petroselinum hortense*
Parsley	Aji	*Capsicum frutescens*
Pepper	Platano macho	*Musa balbisiana*
Plantain	Rabano	*Raphanus sativus*
Radish	Espinaca	*Spinacia oleracea*
Spinach	Tomate	*Lycopersicon esculentum*
Tomato		

∗Based on the 11 gardens observed in Cienfuegos, Cuba

Cultivation techniques include crop rotations, intercropping and the utilisation of natural fertilisers and integrated pest management. Every *organoponico* in Cienfuegos has at least one container bed dedicated to the production of worm compost. Cuban worm composting utilises *Eisenia foetida* and *Lumbricus rubellus* redworms. Whereas manure is the main ingredient in vermicompost, crop residues form the basis of compost piles in the gardens. Soil fertility is maintained through the addition of off-farm sources of organic matter and whatever compost material is produced in the operation. The Enterprise sells organic matter to the urban gardens that it receives from rural farms. Every few months, the gardeners add organic matter to the beds. Through mineralization, the contents of the container beds are reduced making room for the added material. If the fertility in one of the beds is extremely poor then part of the bed may be emptied and new material added.

Another common feature of the *organoponicos* is the production of medicinal plants. Every garden has at least one small container bed dedicated to the production of herbs and spices.

According to the Territorial Plant Protection Division (hereafter known as Plant Protection) of Cienfuegos, there are a variety of diseases and pests that plague the urban gardens. The most common pests and diseases affecting the 11 *organoponicos* are fungal (wilt, belly rot, leaf spot) and the most common pests are leafhoppers, whiteflies, thrips, *margaronia*, nematodes, aphids, mites, caterpillars, snails, and coleoptera (Table 3.5).

Table 3.5 Common diseases and pests in the *organoponicos* of Cienfuegos

DISEASES		PESTS	
Latin Name	**Common Name**	***Latin Name***	**Common name**
Alternaria Solani	Early Blight	*Prodenia Sp.*	Southern Armyworm Moth
Alternaria Brasscal	Leaf Spot	*Manduca Sexta.*	Tobacco Hornworm
Alternaria Porri	Leaf Spot	*Heliothis Zea*	Corn Earworm
Cercespora Sp.	Cercespora Leaf Spot	*Thrips Palmi*	Palm Thrips
Stemphylium Solani	Stemphylium Leaf Spot	*Empoasca Sp.*	Green Leafhoppers
Cladosporium Fulvum	Scab	*Diabrotica Sp.*	Spotted Cucumber Beetle
Septoria Licopercicella	Septoria Leaf Spot	*Aphis Gossypii*	Cotton Aphid
Xanthomona Vesicatoria	Bacterial Leaf Spot	*Myzus Persicae*	Green Peach Aphid
Fusarium Sp	Wilt	*Diaphania Sp.*	Leafwebber
Rhizoctonia Solani	Belly Rot	*Plutella Maculipennis*	Diamond Back Moth
Sclerotinia Rofsi	Bottom Rot	*Margaronia Sp*	___

The Cubans follow an Integrated Pest Management (IPM) plan that stresses prevention through cultural practices, and the use of biological and chemical control. They include the following strategies:

- **Cultural Practices:** Crop rotations, time of planting, selection of resistant varieties, modification of planting distances, insect traps.
- **Biological control:** The use of bacterial, fungal and natural insecticides, beneficial insects
- **Chemical Control:** Conservative use of chemicals authorised by the Plant Protection.

Biological control plays an important role in pest management of the *organoponicos*. In Cienfuegos, the most commonly used organisms in the *organoponicos* are bacteria and fungi (Table 3.6). According to one of the extensionists, biological control products are also applied once a week as a preventative measure. When signs of disease or pests appear, the gardeners double the number of applications.

Table 3.6 Common biological pesticides used in the *organoponicos* in Cienfuegos

Bacterial	*Bacillus thuringensis*: cepa LBT-13, LBT-24, LBT-21
Insecticidal Plants	*Tabaquina* (*Nicotina nustica*)
Fungal	*Beauveria bassiana* *Verticillium lecanii* *Paecilomyces lilacinus* *Trichoderma harzianum*

According to Plant Protection in Cienfuegos, chemical control is used as a last resort when all other alternatives have failed. Several synthetic agrochemicals are authorized for use in the urban gardens (Table 3.7).

Table 3.7 Pesticides authorised by the Plant Protection Division for use in urban gardens

	Chemical Class	Dosage
Insecticides		
Azufre 80%	Sulphur	3-4 kg/ha
Carbaril 85%	Carbamate	2-3 kg/ha
Diazinon 60%	Organophosphate	1-1.5 kg/ha
Dipterex 80%	Organophosphate	1.5-2 kg/ha
Gaucho (seeds)	Chloro-nicotinyl	100g/Kg seeds
Malathion 57%	Organopshosphate	1.5-2 litres/ha
Karate	Synthetic pyrethroid	0.5-1 litre/ha
Pirimor 50%	Carbamate	0.5-1 litre/ha
Cypermethrina	Synthetic pyrethroid	1 litre/ha
Thiodan	Chlorinated hydrocarbon	
Fungicides		
Zineb 75%	Carbamate	2-3 kg/ha
Maneb 80%	Carbamate	2-3 kg/ha
Mancozeb 80%	Carbamate	2-3 kg/ha
Ox. Cobre 50%	Copper oxide	0.4-0.5 kg/ha
Ridomil 72%	Benzoid	2kg/ha
Confidol	Chloro-nicotinyl	
Herbicides		
Gramosonex	Dichloride	
Finalex	Glufosinate	

The Enterprise encourages the exclusive use of biological control and fines gardeners that use unauthorised chemicals. However, unauthorised chemicals are known to circulate on the black market. Concerns in that regard were expressed at one of the cultivators' general meetings.

According to official statistics, in 1999, urban agriculture produced 46% of Cuba's fresh vegetables (Kjartan 2000). In the same year the *organoponicos* in the municipality of Cienfuegos occupied approximately 221,220 m^2 and produced 5061 tons of vegetables. This is an increase from 1998, when organoponicos in the municipality occupied 161, 832 m^2 and produced 4318 tons of food (Sanchez 1999). In 1999, the production from the *organoponicos, huertos* and *patios* and *parcelas,* amounted to 11,714 tons of foods within the municipality of Cienfuegos. The *organoponicos* in Cienfuegos have been quite successful and achieved continuous yield improvements ranging from 4 kg/m^2 in 1994 to

25.9 kg/ m^2 in 1999.

3.3 Case study: La Calsada *organoponico*

The following section contains a detailed description of the case study *organoponico*, La Calsada. The information presented is pertinent to organic certification and has been modelled on farm inspection reports conducted by organic certification inspectors in Nova Scotia, Canada. Organic inspectors act as the "eyes, ears and nose" of the certification process (IOIA 1998). The decision to grant or deny organic certification largely depends on the information contained in the inspector's report.

Overview of the operation

La Calsada has been in operation since 1993 and managed under the supervision and regulations of the Enterprise. The manager and his sister are the principal cultivators and had limited experience when they began cultivating in the early 1990s. By attending government seminars and with the help of extensionists, the manager has been able to develop needed skills and now has one of the most profitable urban gardens in Cienfuegos. The manager pays the Enterprise 415 pesos per month in rent and 60 pesos for social insurance and he estimates that operational costs amount to about 6,100 pesos per year. Two other cultivators provide assistance as required in exchange for space in the back of the garden where they can grow their own crops and keep related profits; these crops are grown in raised beds as opposed to containers. A regular workday in La Calsada usually begins at dawn, around 6:00 to 6:30 a.m., and continues until noon when the cultivators break for lunch and a siesta. Typically the gardeners return to work around 3:00 p.m. and finish at 6:00 p.m.

The container beds occupy a net area of 1000 m^2 while the total area under cultivation is approximately 1100 m^2. There are 28 *canteros* that are 33 m long by 1.2 m wide and 3 *canteros* that are 15 m long and 1.2 meters wide. Other installations in the garden include a water tank, outhouse, small *plazita* (kiosk) from which the produce is sold and a tool shed. The water tank was not being used due to the lack of a pump. The tools used in the garden include a shovel, a pick, a rake, a sprayer and other makeshift tools that aid in production. No mechanized tools are used. The produce is sold directly out of the garden, with no packaging or processing. The garden is entirely fenced to keep out thieves and trespassers.

The primary crops of this operation are lettuce produced mainly during the dry season (November-April) and string beans during the rainy season (May-October). Secondary crops during the dry season include beets, carrots, chard, tomatoes, cabbage, and celery. Peppers are cultivated all year round while during the rainy season okra, chard, chives, and onions are cultivated. One 15 meter container bed is dedicated to the cultivation of medicinal plants and condiments.

Risk of contamination from neighbours

The garden is located in the central part of the city directly opposite one of the farmer's markets (Appendix A, map 3). A main road borders the garden to the south, a neighbourhood to the west, and to the north a small creek and urban farm and residences to the east (see figures.3.1, 3.2, 3.3). One potential source of contamination especially lead is the traffic that passes in front of the garden. Also, drift from the urban farm and contaminated water from the creek are potential sources of contamination. The crops are about 7 m away from the road and 5 m from the creek.

A soil test was conducted to determine whether there are heavy metal excesses in the garden. In organic operations the application of manures and organic fertilisers may lead to increased heavy metal concentrations, it is therefore important to monitor the soil to maintain an optimal balance. In the urban gardens heavy metals such as lead are also a concern due to their proximity to heavily used roads. The results of the soil analysis indicate that only copper and zinc exceed acceptable levels for agricultural lands as designated by the Canadian Soil Quality Guidelines[7] (CCME 1999) (Table 3.8, also see Appendix E). In spite of La Calsada's proximity to a heavily used road lead concentrations were on average 15.6 mg/kg. According to the CCME (1999) guidelines the acceptable maximum concentration for lead in agricultural lands in 70 mg/kg while for compost it is much higher at 150 mg/kg.

Table 3.8 Copper and zinc concentrations of 5 soil samples for La Calsada

[7] CCME guidelines for agricultural lands allow up to 63 mg/kg of copper and 200 mg/kg of zinc. On the other hand the guidelines for compost quality are higher at 100 mg/kg for copper and 500 mg/kg for zinc.

Soil Sample	Heavy metal	Content (mg/kg)	Heavy metal	Content (mg/kg)
Sample 1	Copper	120	Zinc	430
Sample 2	Copper	110	Zinc	400
Sample 3	Copper	82	Zinc	220
Sample 4	Copper	66	Zinc	200
Sample 5	Copper	95	Zinc	370

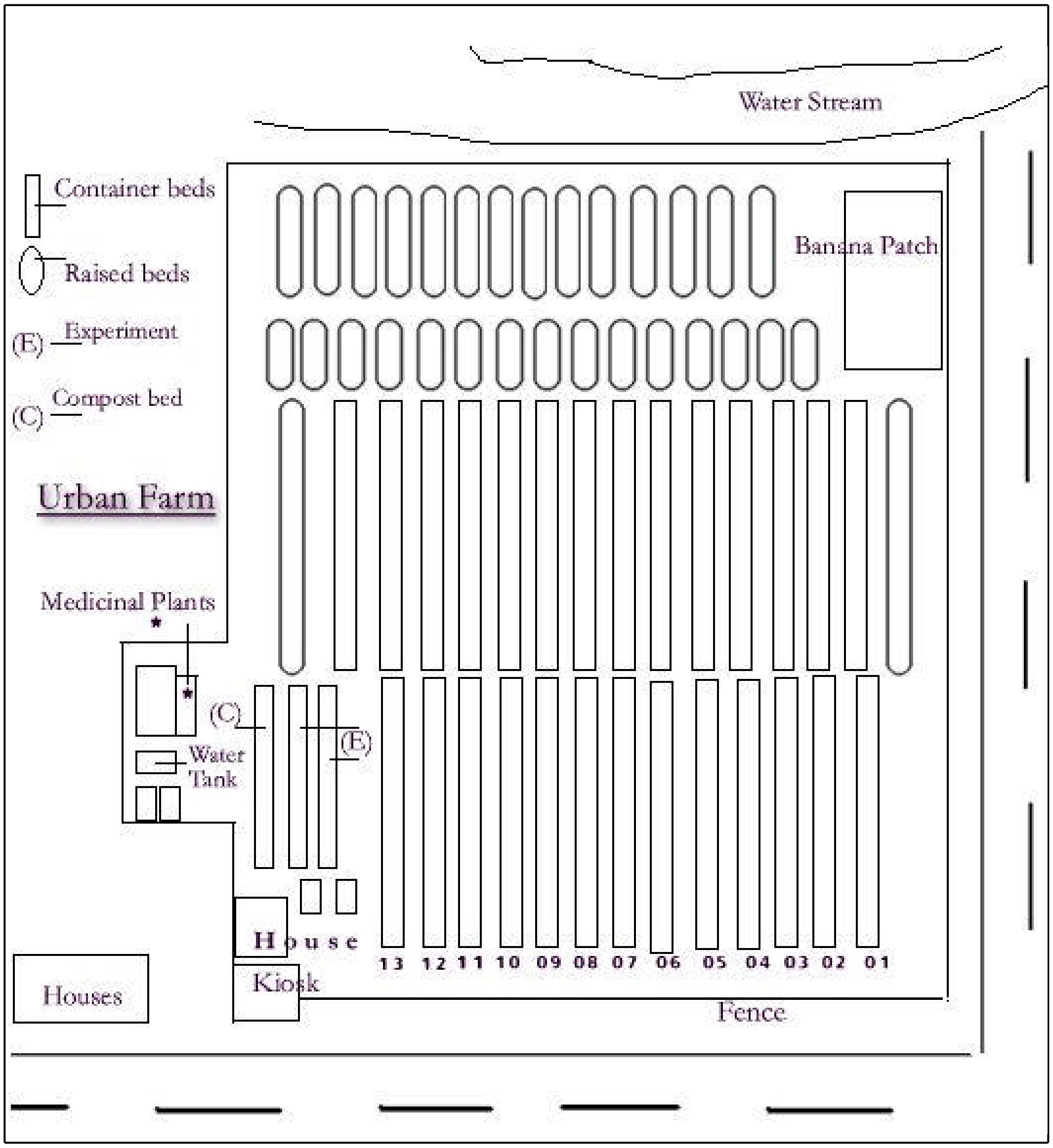

Fig.3.1 Diagram of the La Calsada *organoponico* (not to scale)

Fig.3.2 Bird's eye view of La Casalda *organoponico:* frontal

Fig.3.3 Bird's eye view of La Casalda *organoponico:* back view

There is no buffer zone between the neighbouring urban farm and La Calsada. The neighbouring farm is cultivated by a family that also sells their produce from La Calsada's kiosk. The land is being farmed using methods analogous to those of the *organoponico*; the difference is that they cultivate directly into the soil as opposed to *canteros.* The proximity of the farm is a cause of concern since any chemicals used have the potential to drift into La Calsada.

Irrigation water

The garden has a well, but the water salinity is excessive therefore crops are watered with potable water from the city's main aqueduct once in the morning and once in the afternoon. A rubber tube sprinkler system has been installed in five of the beds but the majority of the watering is done manually. This work is labour intensive thus one person dedicates the entire morning to watering the garden. As mentioned earlier, there is a water tank in the garden with a holding capacity of 7 m cubed but it was not being used at the time due to the lack of a water pump. In other gardens, similar tanks are filled in the morning and subsequently used to water the crops by gravity. During the dry season approximately 2000 litres of water are used daily while in the rainy season the same amount is used every other day.

Soil tests

The Enterprise conducts soil tests on an annual basis and as needed when there appears to be a soil deficiency. A soil test was conducted for La Calsada in 1998, but in 1999 no tests were done. The manager stated that some of the container beds were nutrient deficient and to deal with it compost and organic matter supplied by the Enterprise were added to the bed.

Crop rotations

According to the manager, the golden rule of cultivation is to not grow the same crop more than twice in succession in the same container bed. In his case, this rule may be compromised depending on the financial situation of the garden. During the months of October, November and December, lettuce dominates the majority of the container beds. It is easy to cultivate, grows fast and is very popular, especially around Christmas. On average, lettuce is grown three times in one bed before the crop is rotated. Once the lettuce season is over, string beans occupy the majority of the beds. Intercropping is also practised. Some examples include planting lettuce with tomatoes, chard with string beans, and radish with string beans.

Crop conditions

The crops of the garden appeared to be in excellent condition; the plants were robust and there were no signs of disease. During the 3 months I spent in the garden the following crops were cultivated: beets, string beans, tomato seedlings (sold as transplants), plantain, peppers, medicinal plants and lettuce. When the string bean season ended the plants were removed and added to the compost bed. It is worth noting that the roots were nodulated. After October 15, 1999, the majority of the container beds were planted with lettuce. Last year's overall yield reached 27 kg/m^2.

Seeds and transplants

There are three sources of seeds in Cienfuegos. Seed can be purchased from the Enterprise or from a state-owned seed distributor located in the city of Cienfuegos. Gardeners also save as many seeds as possible from their own production. In La Calsada one of the container beds is usually dedicated to seed production particularly for crops such as string beans. In Cuba, not all plants go to seed because of high temperatures (i.e. cabbage, radish, carrot, beets) thus gardeners are forced to buy many of the seeds they use, annually. Small seeds, especially lettuce seeds, are treated with carbaryl or thiodan (approximately 0.5-1kg per year) to deter ants from carrying them away and feeding on them. All tomato seeds are treated with gaucho to prevent disease. The Enterprise suggests that all tomato transplants be purchased from the local *hydroponic* operation to avoid disease and pest infestations. However, many of the seedlings of other crops are produced on-site.

Weed and pest management

Gramosonex or Finale is sprayed 4 or 5 times per year in the spaces between the container beds to get rid of weeds. Once a week the beds are weeded manually. The most common pest outbreaks in La Calsada involve whiteflies (which transmit a pathogenic virus), aphids, and leaf-hoppers. The manager maintains that during the summer months biological pesticides are not sufficient for the control of aphids. The worst time for aphids is between July and August. In 1999, the garden was sprayed with pirimol (136 g/ 16 lt. of water) due to aphid infestations.

In terms of biological control, the crops are treated with *Bacillus thuringensis*, *Beauvaria bassiana*, and *Trichoderma harzianum* (insecticides). Usually _ litre of biological control is mixed with water in a 16-litre sprayer and two spray tanks, or 32 litres are applied every week. Tobacco residues or *tabaquina* are used as an insecticide and calcium hydroxide is applied to desiccate the eggs of insects as well as fight fungus outbreaks. *Tabaquina* has to be treated with calcium hydroxide before it is applied to protect against the tobacco mosaic virus. At the end of each container bed sorghum has been planted to act as food for pests while attracting beneficial insects.

About 500 g of Carbaryl per year are used on seeds to deter ants from feeding on them. Approximately 450 g of calcium hydroxide are diluted in 16 litres of water and applied to six 33 metre *canteros*. In September of 1999, 5 container beds seeded with cucumber had to be cleared due to a viral disease.

Soil fertility

The composition of the substrate in the container beds is approximately 10% gravel, 20% soil and 70% organic matter. One of the 15m container beds is dedicated to worm composting. Plant residuals, oxen manure and horse manure are fed to the worms. Worm compost is added to the canteros (1 kg per m^2) every second or third harvest or as needed. There are other small mounds of compost around the garden but the main source of organic matter is the Enterprise. Organic matter is purchased from the Enterprise at 9 pesos per ton and added to container beds every few months depending on their state. In 1999, approximately 12 truckloads (est. 50 m^3) of sugarcane filtercake (*cachaza*) were purchased. Furthermore, at the rate of 1 kg per m^2 at least 3 tons of compost are added per year to the beds.

The crops in La Calsada are also occasionally sprayed with urea when it appears they are a little stressed. Urea was recently applied (150 g per 16 l of water) because it was felt the crops had been weakened by hurricane Irene. Usually 2.5 sprayer tanks will accommodate the needs of the whole garden. The garden is sprayed with urea once a week every two weeks. In the life cycle of lettuce it will be sprayed twice.

Nutrient limitation experiment

A nutrient limitation experiment was performed in one of the container beds using leafy green lettuce (*lactuca sativa* BH-15) to assess possible nutrient deficiencies in the La Calsada *organoponico.* Three treatments were applied: control (no additions), nitrogen, phosphorus and potassium (9-2-5) organic fertiliser (mixed treatment) and potassium sulphate fertiliser (potassium treatment) applied in four repetitions. Two harvests were conducted and the weight and number of plants were recorded. The mean yields of the three treatments are presented in the following figure (figure 3.4).

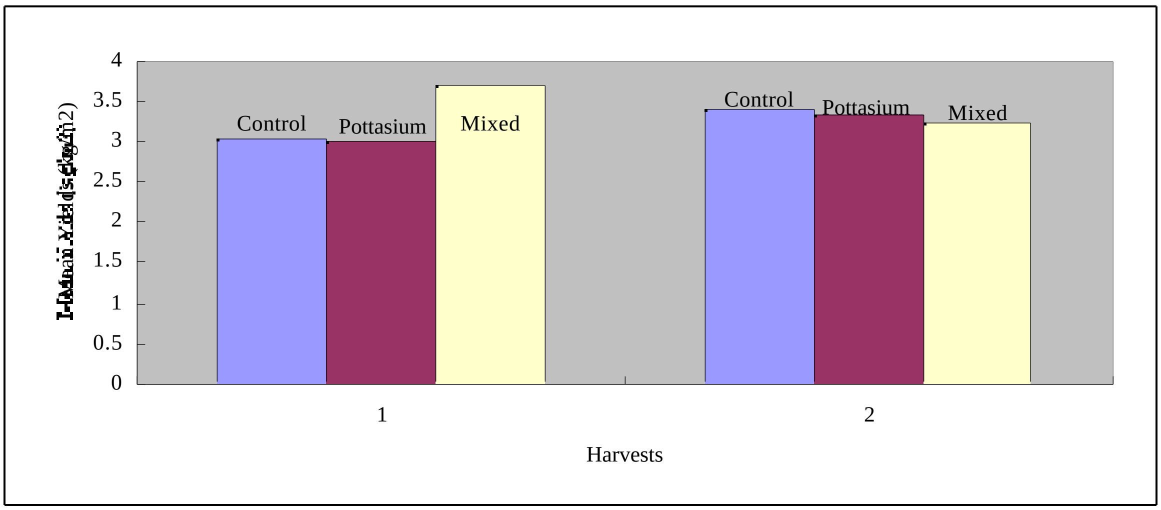

Figure 3.4 Mean yields (fresh weight) of the three treatments

Differences between means assessed by Fisher's Protected LSD, indicated no significant differences between treatments ($\alpha < 0.05$) (see Appendix F). The first harvest exhibited a trend for a difference (α=0.10) between the control and mixed treatments and the potassium and mixed treatments. The mean of the mixed treatment was 17% higher than that of the control and 18% higher than that of the potassium treatment. In the second harvest there were no significant differences between any of the treatments (α=0.10). Fertiliser was not reapplied in the second harvest but lettuce was planted in the same container to test the residual effects of the fertilisers.

Results of leaf tissue and soil sample analyses

Leaf tissue analyses and soil tests were performed after the first harvest. The analysis was performed at the Harlow Institute in Truro, Nova Scotia for each of the treatments, to determine the nutrient content. The leaf tissue analysis indicated nitrogen values of 3.7% for the control treatment, 3.48% for the mixed treatment and 3.58% for the potassium treatment (table 3.9). Phosphorus values were 0.64% for control, 0.68% for the mixed and 0.68% for the potassium treatments. Potassium values were 5.92% for the control, 5.91% for the mixed and 5.99% for the potassium treatment.

Table 3.9 Lettuce tissue analysis report-first harvest

Treatment	Control	Mixed	Potassium
Nitrogen (%)	3.7	3.48	3.58
Phosphorus (%)	0.64	0.68	0.68
Potassium (%)	5.92	5.91	5.99
Calcium (%)	1.62	1.47	1.52
Magnesium (%)	0.34	0.32	0.33
Iron (ppm)	204.48	231.62	201.66
Copper (ppm)	35.51	37.50	39.86
Zinc (ppm)	8.73	7.17	8.28
Boron (ppm)	41.15	38.14	42.05
Dry matter (%)	35.52	35.23	35.89
Sulfur (%)			
Sodium (%)			

A leaf tissue analysis was also performed on the second harvest in Cuba. The results of the leaf tissue analysis for the second harvest indicate lower levels of nitrogen, phosphorus and potassium in all treatments compared to the first harvest (table 3.10). Nevertheless, in both cases the nutrients are within acceptable ranges (Lorenz and Maynard 1988)[8].

[8] [8] At heading, lettuce would be considered deficient when N:0.15, P:0.2, and K:2.5 whereas they are considered sufficient when N:3, P:0.35 and K:5. Near maturity the following values indicate deficiency: N:1.25, P:0.15 and K:2.5. They are considered sufficient when N:2.5, P:0.3 and K:5.

Table 3.10 Lettuce tissue analysis report-second harvest

Treatment	Control	Mixed	Potassium
Nitrogen (%)	3.8	3.46	3.34
Phosphorus (%)	0.57	0.581	0.583
Potassium (%)	4.8	5.16	5.44
Calcium (%)	1.48	1.34	1.34
Magnesium (%)	0.24	0.2	0.17

The soil analysis rated phosphorus, potassium and calcium as excessive in all treatments (table 3.11).

Table 3.11 Soil test results

Treatment		Control		Mixed		Potassium	
Crop		Lettuce		Lettuce		Lettuce	
		Analysis	**Rating**	**Analysis**	**Rating**	**Analysis**	**Rating**
PH		7.1		7.2		7.2	
Organic Matter (%)		11.7		12.4		12.5	
P2O5 (kg/ha)		5845	E	5186	E	5724	E
K2O (kg/ha)		1065	E	1001	E	1388	E
Ca (kg/ha)		14860	E	14100	E	15620	E
Mg (kg/ha)		910	H+	941	H+	1034	H+
Na (kg/ha)		50		58		62	
Sulfur (kg/ha)							
Fe (ppm)		157		145		149	
Mn (ppm)		44		39		44	
Cu (ppm)		17.83		17.3		18.84	
Zn (ppm)		121.5		118.4		126.2	
B (ppm)		1.36		1.34		1.45	
Nitrate –N (ppm)							
Salt (mhos x10^{-3})							
CEC (meq/100gm)		44.8		43.0		47.4	
Base Sat.	K (%)	2.5		2.5		3.1	
	Ca (%)	82.9		82.0		82.3	
	Mg (%)	8.5		9.1		9.1	
	Na (%)	0.2		0.3		0.3	
	H (%)	5.9		6.1		5.2	
Lime required (t/ha)		6	6.5	6	6.5	6	6.5
RNA							

RNA (kg/ha)	N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O
	150	0	0	150	0	0	150	0	0

RNA= Required Nutrient Applications **L=Low M=Medium H=High E=Excessive**

Harvesting and marketing

All harvesting is done manually. The garden is located in a commercial part of the city opposite from a local farmers market and the produce is sold immediately after harvest to the public. In fact, during harvesting people will line up to purchase the produce. Other gardens bring their produce to La Calsada for sale because of its location.

Strengths and weaknesses of this operation

The major strengths of this operation are the commitment of the cultivators and its close proximity to the farmer's market. The weakness is its dependence on the municipality for its water and off site-sources of organic matter. The cultivators confirmed this indicating that their major limitation was organic matter availability and quality. The implementation of a strong fertility-building program might alleviate this problem.

Record keeping and audit trail

Rough sales records are kept on a daily basis. At the end of the month the manager must make an official report of his sales to the Enterprise. Yields are recorded but are done so in a haphazard manner. In most cases, the cultivators estimate yields based on the amount of money they make per container bed. For example, if they sold 200 pesos worth of lettuce from a 15 metre bed, they assume that one bunch of lettuce that sold for 1 peso weighed 1 pound, thus a 15 meter bed will have yielded 200 pounds of produce. They do not measure out square meters nor do they weigh the yield. The manager keeps mental records of the inputs that are utilised in the garden but sufficient records of production inputs to conduct an audit trail are lacking.

Other contributions

The La Calsada *organoponico* is an educational destination for many junior high school students. The manager frequently spends the morning explaining how the garden operates and then he puts the students to work, usually at weeding. During this research, 3 students were regular volunteers in the garden. One of them was working towards a career as an agronomist. On average, the volunteers spent 4 hours a week working in the *organoponico.*

3.4 Compliance to Canadian organic standards

According to the National Standard of Canada, organic agricultural foods are produced and processed under a system that strives to preserve the integrity of the principles outlined in CAN/CGSB-32.310-99. The Canadian National Organic standards specify the minimum criteria that must be met for agricultural food products and inputs to be defined as organic. The standard outlines principles of organic agriculture that promote sound production and management methods to enhance the quality and sustainability of the environment. The following general principles form the foundation of organic production (CGSB p.iv):

- Protect the environment, minimise soil degradation and erosion, decrease pollution, optimise biological productivity and promote a sound state of health.
- Replenish and maintain long-term soil fertility by optimising conditions for biological activity within the soil.
- Maintain diversity within and surrounding the enterprise and protect and enhance the biological diversity of native plants and wildlife.
- Recycle materials and resources to the greatest extent possible within the enterprise.
- Provide attentive care that promotes the health and behavioural needs of livestock.
- Maintain the integrity of organic food and processed products from initial handling to point of sale.

Required practices include: following well-designed crop rotations; establishing and maintaining high levels of organic matter and soil biological activity through sustainable soil management techniques and maintaining detailed production records (i.e. documenting the use of inputs and sales). Prohibited practices include the use of synthetic pesticides and fertilisers and the use of genetically engineered organisms (COG 2001).

The operations of the 11 *organoponicos* were assessed relative to the principles of organic agriculture such as crop rotations, soil fertility management and pest management. The La Calsada *organoponico* was studied in detail while additional information was collected from 10 other *organoponicos* (Appendix G). In many cases there is compliance to standards while in others the cultivators would have to significantly change their practices to meet the requirements. The information collected from the 11 gardens was used to consider whether these operations are in compliance to specific standards.

Standards 5 on Organic Production Plan and Records, and 6 on Crop Production were considered in this analysis. Permission was not granted to reproduce the CGSB standards in this document therefore the standards have been paraphrased in the discussion.

If the practices in the *organoponicos* were perceived to be in compliance to a particular standard then the performance of the *organoponicos* in relation to that standard was designated as A. A rating of B indicates that the practices of the gardens were not entirely in compliance to that particular standard but would require only minor changes to meet the criteria. If the practices in the *organoponicos* were not considered to be in compliance to the standard and required significant changes in practices to meet the standard they were assigned a score of C. Finally, if a particular standard was not applicable to the *organoponico* operations it was assigned a rating of D (Table 3.12 and Table 3.13).

Table 3.12 Organic production plan and records performance of the 11 *organoponicos* in relation to Canadian organic certification standards.

Standard	Performance of the organoponico
Production plan (5.1)	
♦ preparation of production plan (5.1.1)	C
♦ elements of production plan: map, rotation, description of cultivation techniques, sources of inputs etc. (5.1.2)	C C
Parallel production (5.1.3)	D
Records and Record Keeping (5.1.4)	
♦ records of inputs and production (5.1.4a)	C
Handling and Processing Plan	D
Waste Management (5.3)	
♦ efforts to reduce solid and/ or liquid wastes (5.3.1a)	B
♦ recycling efforts (5.3.1b)	A

A- In compliance with the standard
B- Embraces organic principles but is not entirely in compliance. Requires some changes in practice.
C- Not in compliance with this standard. Requires significant changes in practice.
D-This standard does not apply to the *organoponico* operation

Table 3.13 Performance for crop production of the 11 *organoponicos* in relation to Canadian Organic certification standards.

Standard	Performance

Crop Production (6.0)	
Environmental factors (6.1)	
♦ Neighbouring contamination (6.1.1.& 6.1.2)	B
♦ Quality of irrigation water (6.1.3)	B
♦ Soil erosion (6.1.4)	A
Variety selection (6.2)	
♦ Prohibition of GMOs (6.2.1)	A
♦ Locally adapted and disease resistant varieties (6.2.2)	A
♦ Measures to enhance genetic and biological diversity (6.2.3)	A
♦ Production of annual seedlings and transplants (6.2.4)	B
Rotations (6.3)	
♦ Diverse crop rotations	B
♦ Use of legumes, green manure crops and deep-rooted plants (6.3.1)	D
Soil Management (6.4)	
General principles of organic soil management (6.4.1)	
♦ Establishment and maintenance of fertile soil (6.4.1.1)	B
♦ Sources of organic matter (6.4.1.2)	C
♦ Prohibition of GMOs (6.4.1.3)	A
♦ Prohibition of sewage sludge (6.4.1.4)	A
♦ Soil tests (6.4.1.5)	B
♦ Tillage practices (6.4.1.6)	D
♦ Fertilisation practices (6.4.1.7)	B
♦ Prevention of soil erosion (6.4.1.8)	D
Recommended Practices of Organic Soil Management (6.4.2)	
♦ Use of compost (6.4.2.1)	A
♦ Application of fresh manure (6.4.2.2)	A
♦ Use of off-farm sources of manure (6.4.2.3)	D
♦ Off-farm sources of compost (6.4.2.4)	D
♦ Cultivation of legumes (6.4.2.5)	B
♦ Cultivation of “catch” and deep-rooted crops (6.4.2.6-7)	D
Disease and Pest Management (6.5)	
♦ Use of resistant varieties (6.5.1)	A
♦ Encouragement of natural predators (6.5.2)	A
♦ Use of synthetic pesticides (6.5.3)	C
♦ Sanitation of equipment (6.5.4)	B
♦ Thermal sterilisation (6.5.5)	D
Weed Management (6.6)	
♦ Use of synthetic herbicides (6.6.1)	C
♦ Management techniques (6.6.2)	B
♦ Physical weeding methods (6.6.3)	A
Growth Regulators (6.7)	A
Plastic materials (6.8)	A
Buffer zones (6.9)	C

A- In compliance with the standard
B- Embraces organic principles but is not entirely in compliance. Requires some changes in practice.
C- Not in compliance with this standard. Requires significant changes in practice.
D-This standard does not apply to the *organoponico* operation

The following section specifies the reasons why certain practices of the *organoponicos* are not in compliance with specific organic certification standards (those scored as B and C). Explanations are also offered for the standards that were deemed non-applicable for the *organoponico* operations.

Organic production plan and records

Standard 5.1.1 requires that applicants for organic certification prepare a thorough production plan that outlines the details of the management practices including rotations, fertilisation, crop protection, harvest, post-harvest treatments and livestock practices (if applicable). According to standard 5.1.2, the production plan should include a detailed map, a written description of the rotation plan, all inputs, cultivation techniques, sources of seeds, equipment used etc. Out of the 11 gardens that were visited only one had a map of the operation while all of them lacked documented production plans. In all gardens, the managers stated that they kept mental notes of the rotation plans, inputs, fertilisation, crop protection, etc.

Parallel production

Standard 5.1.3.1 states that in cases where there are operations with organic and non-organic production systems in parallel production, appropriate measures need to be taken to ensure organic integrity. This standard is not applicable to the *organoponicos* as parallel production does not exist in these systems.

Records and record keeping

Standard 5.1.4 requires that the operation maintain records of all inputs and production detailed enough to demonstrate adherence to the standard. In all of the 11 gardens, input records were lacking. In all of the gardens the managers recorded rough estimates of the type and quantity of produce that they sold on a daily basis.

Handling and processing plan

Standards 5.2.1 and 5.2.2 outline the organic handling and processing requirements necessary for ensuring that agricultural products labelled and marketed as organic are in accordance with the standards. This standard is not applicable to the operation of the *organoponicos* as the products are not currently being marketed as organic, nor are they being marketed through impersonal food distribution systems.

Waste management

According to standard 5.3.1, the operation should have a written description of efforts taken to reduce all forms of waste (solid and/or liquid waste and airborne emissions) and it should practice recycling as much as possible. In all of the gardens, written descriptions of the efforts taken to reduce waste were lacking however these systems are producing very little wastes. The bulk of the waste materials produced in the gardens are recycled through composting. The operation of the gardens is labour intensive and un-mechanised thus they produce limited airborne emissions. Regarding solid and liquid wastes, the gardens appear to be non-polluting, but since they are importing large quantities of manure and compost, the potential for nutrient loading exists.

Crop production: environmental factors

According to standards 6.1.1 and 6.1.2, measures such as establishing buffer zones must be taken to minimise contamination from neighbouring areas of substances prohibited by the standards. The limitation with the *organoponicos* is that they are located in urban areas where there is potential for contamination from traffic, factories and other human oriented activities. For instance, La Calsada is borders an urban farm and a heavily used road. Chemical residue analyses would help substantiate that risk. Another limitation is that *organoponicos* located in areas with higher risks of contamination (due to their proximity to industries and roads) lack sufficient buffer zones. Another factor to consider is the occasional mosquito fumigation in the urban areas. In such cases the gardens would be exposed to pesticides.

Standard 6.1.3 requires that measures be taken to monitor the quality of irrigation water especially where there is a risk of prohibited substances being used upstream. In only one case was water being drawn from a creek and there was sufficient evidence to suggest rigorous water quality monitoring was lacking. This issue is exacerbated by the fact that many of the waterways around and in the city are polluted. The rest of the gardens were using water from their wells or the city's aqueduct (this water is potable).

According to standard 6.1.4, measures should be taken to control soil erosion. These measures include but are not limited to appropriate cultivation practices (such as reduced tillage, use of cover crops), efficient water drainage or other controls. The *organoponico* operations are unique in that cultivation for most part takes place inside cement containers. Because these systems are intensive, the soil is rarely left uncovered. The location of the gardens (surrounded by buildings that act as windbreaks) and the design of the operation contribute to soil conservation.

Variety selection

Standard 6.2.4 requires that all seedlings and transplants be produced in accordance to the principles outlined by the standard. The majority of the *organoponicos* produce their own seedlings but they are encouraged to purchase tomato seedlings from the local *hydroponic* operation that raises virus free tomato seedlings. The limitation is that hydroponics operations are not based on organic principles as various inorganic "nutrient broths" are fed to the plants via an inert medium that replaces soil. Most of the seeds are also chemically treated with gaucho, carbaryl or thiodan.

Rotations

Standard 6.3.1 calls for diverse crop rotations and the use of green manures, deep-rooted plants and legumes. In all of the gardens, at some point at least one leguminous crop was incorporated into the crop rotation. String beans are the main legume and they are planted in the summer. *Organoponicos* are intensive food production systems that at this point in time cannot afford to apply green manures. Every square meter is needed in food production. When food security is not a pressing issue green manures could be incorporated into the system. In addition, deep-rooted crops are not cultivated and few of the crops are leguminous. All of the gardens lack definite crop rotation plans. The golden rule that was followed was "never grow the same crop in the same bed successively", but this rule was not always the followed. There was a significant difference in the number of crops planted in each garden. La Calsada was not very diverse compared to some of the other gardens that had 15 or more crops planted at one time. This diversity was achieved through extensive intercropping.

General principles of organic soil management

According to standard 6.4.1.1, the main objective of a soil management plan is the creation and maintenance of fertile soil using practices that enhance soil humus and soil biological activity. The majority of the *organoponicos* are not self-sufficient in terms of soil fertility but rely on off-farm sources of organic matter and compost.

Standard 6.4.1.2 states that the organic matter produced in the operation will constitute the bulk of the fertilisation program, supplemented with organic matter from approved off-farm sources. In the *organoponicos* studied, off-farm sources constitute the bulk of the fertilisation program for all 11 gardens. Only three *organoponicos* continuously compost horse manure produced in the city (because they are located very close to horse manure depots[9]) while the remainder rely on other outside sources for organic matter. La Calsada, does not have an extensive compost production program and was heavily dependent on the Enterprise to supply organic matter. The sources of the manure and *cachaza* supplied by the Enterprise would have to be assessed to determine their appropriateness.

Standard 6.4.1.5 recommends soil testing to monitor soil organic matter levels, soil pH, macronutrient and micronutrient levels, cation exchange capacity and percent base saturation. In the majority of the *organoponicos*, the managers stated that the Enterprise conducts soil tests on a yearly basis while in some cases soil tests are only conducted when nutrient deficiencies are suspected. The managers of the *organoponicos* did not have any of the soil test results and they were not rigorous about monitoring.

Standard 6.4.1.6 states that tillage practices should be aimed at minimising damage to the structure and tilth of soil. This standard does not apply to the *organoponicos* as the beds are at least 50% organic matter and are cultivated and tilled intensely. When the beds are prepared for planting they are tilled and left to dry for a few hours in the sun to deter nematodes before they are planted.

According to standard 6.4.1.7, fertilisation practices should be geared towards conserving soil and plant nutrients while the addition or removal of excessive levels of nutrients is discouraged. La Calsada, along with 7 other gardens, had used urea or a synthetic foliar fertiliser to increase fertility. The use of these substances is prohibited under the standards. Another limitation is that because they are importing high levels of off-farm compost there is potential for nutrient excesses.

Standard 6.4.1.8 applies to cultivated fields and calls for the use of cover crops and mulching with crop residues as a means to reduce soil erosion. This standard does not apply to the *organoponicos* as the crops are planted in container beds and are rarely left fallow.

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[9] Since the early 1990's Cienfuegos has encouraged the use of horse pulled carriages for transportation. The manure from the animals is captured and deposited at the end of the day in special bins that are made accessible to the gardeners.

Recommended practices of organic soil management

Standards 6.4.2.3 and 6.4.2.4 discourage the use of off-farm sources of manure and compost. These standards are not applicable to the urban garden systems as they rely heavily on off-farm sources of compost and manure. Nevertheless out of the 11 gardens, three were more self-sufficient in soil fertility due to their extensive onsite compost production.

Standard 6.4.2.5 prescribes the use of legumes as a means of fixing atmospheric nitrogen in the soil. The limitation with the *organoponicos* is that they do not incorporate a wide range of legumes in the production plan. In La Calsada and the other gardens, the only leguminous crop that is cultivated on a seasonal basis is string beans.

Standards 6.4.2.6 and 6.4.2.7 prescribe the use of deep-rooted crops or ‘catch” crops for the purposes of maximising soil nutrients and subsoil drainage. These standards are not applicable to the *organoponicos* due to the nature of the container beds. Deeper soil horizons are non-existent and due to the intensity of cultivation, “catch” crops are not an option.

Disease and pest management

According to standard 6.5.3, all synthetic pesticides are prohibited except where noted in the permitted substances list of the standard (CGSB 1999). In all 11 *organoponicos,* prohibited synthetic pesticides were occasionally used while chemically treated seeds were quite common (Table 3.16). La Calsada is using 0.5-1 kg of Carbaryl per year while most tomato seeds that are sold are chemically treated with gaucho.

Standard 6.5.4 requires that all equipment be cleaned thoroughly between uses to remove residues of applied substances. The majority of the *organoponicos* use one spray applicator for all of their pest management inputs and nutrient supplements. Measures would have to be take to ensure the proper cleaning of equipment. Standard 6.5.5 concerning thermal sterilisation of soil and compost is not applicable to the *organoponicos* as this technique is not currently being used.

Weed management

According to standard 6.6.1 all synthetic herbicides are prohibited. La Calsada and two other gardens used prohibited herbicides (gramoxone and finale) to clear weeds from the passages between the container beds.

Buffer zones

Standard 6.9 requires that buffer zones be sufficient in size or other features to prevent the possibility of contamination from neighbouring areas. In some cases, the gardens were very close to heavily used roads, industries, and urban farms. In these instances sufficient buffer zones would be required. According to OCIA (2000), a minimum 25-foot buffer zone on its border with the neighbouring farm would be required to mitigate contamination through drift.

Table 3.14 Restricted or prohibited inputs used in the 11 *organoponicos* (CGSB 1999 and OMRI 1998)

Product	Organic Status
Fertilisers	
♦ Urea	Prohibited
♦ Synthetic Fertiliser formula (PKN)	Prohibited
Insecticides	
♦ Carbaryl (carbamate)	Prohibited
♦ Cypermethrin (synthetic pyrethroid)	Prohibited
♦ Gaucho (Chloro-nicotinyl)	Prohibited
♦ Karate (synthetic pyrethroid)	Prohibited
♦ Pirimor (carbamate)	Prohibited
♦ *Tabaquina* (active ingredient nicotine)	Prohibited
♦ Tamaron (organophosphate)	Prohibited
♦ Thiodan (chlorinated hydrocarbon)	Prohibited
Fungicides	
♦ Calcium Hydroxide	Restricted
♦ Copper	Restricted
♦ Maneb (carbamate)	Prohibited
♦ Mancozeb (carbamate)	Prohibited
♦ Parathion (organophosphorus)	Prohibited
♦ Zineb (carbamate)	Prohibited
Herbicides	
♦ Gramoxone (dichloride)	Prohibited
♦ Finale (Glufosinate)	Prohibited
Soil Amendments	
♦ Organic Matter (off-farm sources)	Restricted

Main findings of the certification study

The La Calsada *organoponico* is functionally organic in that the major flows of the system are organic. An integral component of the soundness to the operation is the health of the soil. In La Calsada there was no evidence to suggest nutrient limitations. On the contrary, the soil analyses indicated excesses of phosphorus and potassium. Furthermore, based on the results of the soil analysis there was no evidence to suggest significant heavy metal excesses in the system. In spite of the *organoponico's* proximity to a heavily used road lead concentrations were present at concentrations well below acceptable limits.

However, the practices of La Calsada and the other 10 gardens examined do not comply with all of the standards outlined by the Canadian General Standards Board therefore can not be referred to as "organic" under this definition. Nevertheless, these systems could attain organic certification with relatively few changes in inputs and practices.

CHAPTER 4
DIETARY ROLE OF *ORGANOPONICOS*

This chapter contains data obtained from 41 patrons of the La Calsada *organoponico* along with information collected through casual conversations and informal interviews with cultivators. Information is also presented from the interviews with three persons considered to be experts in nutrition in the city of Cienfuegos. Personal observations have also been incorporated into this chapter regarding food issues.

4.1 Socio-demographic information of interviewees

Of the 41 interviewees, 56% were male and 44% were female. The majority of the participants were employed (fig 4.1) and over the age of fifty (fig 4.2) with a mean age of 61.5 years (fig 4.3). Approximately 63.4 % of the participants had family nuclei of four or more members (Fig 4.4).

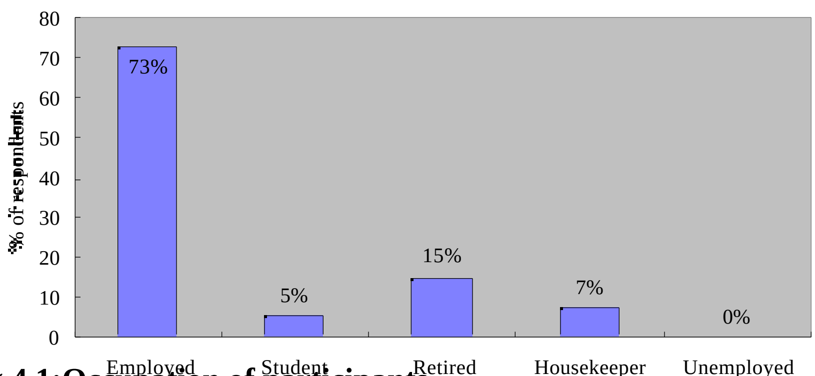


Fig 4.1:Occupation of participants

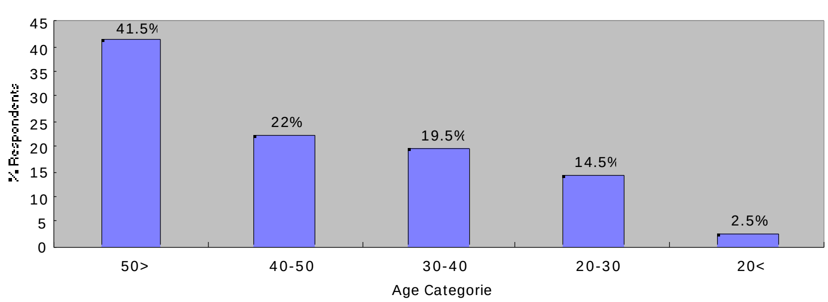


Fig 4.2 Age distribution of participants

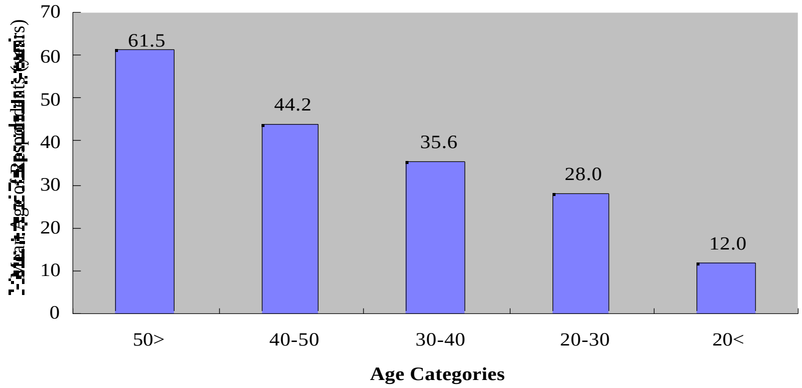
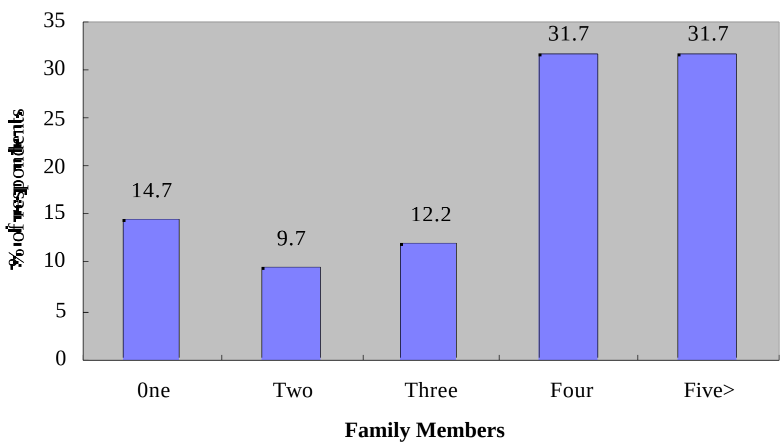


Fig 4.3 Average age of participants



4.2 Dietary profile of participants

The most popular food was rice. Approximately 97% of the respondents consume rice on a daily basis (Table 4.1). Beans are the second most consumed food while vegetables follow cooking oils and tubers. The majority of the interviewees consumed meat, fish eggs and fruit on a weekly basis.

Table 4.1 Food consumption patterns of participants

Food type	Daily consumption	Weekly consumption	Monthly consumption	Zero consumption
Rice	97.5 %	3 %	0 %	2.5 %
Beans	85.3 %	12.2 %	2.5 %	0 %
Oils	73.2 %	17.1 %	9.7 %	0 %
Viandas	65.8 %	31.7 %	2.5 %	0 %
Vegetables	61 %	31.7 %	4.8 %	2.5 %
Milk	36.6 %	26.8 %	14.6 %	22 %
Eggs	39 %	58.5 %	2.5 %	0 %
Fruits	26.8 %	61 %	9.7 %	2.5 %
Meat	9.7 %	63.5 %	26.8 %	0 %
Fish	2.5 %	70.8 %	17.1 %	9.7 %

The results of the z-tests indicate that the proportion of participants eating vegetables on a daily basis exceeds the proportion of participants eating meat (z=4.93). The proportion of respondents consuming vegetables on a daily basis is greater than the proportion of respondents consuming fruits (z=2.67). The proportion of participants consuming tubers on a daily basis equals the proportion of participants consuming vegetables (z=0.68). Finally, the proportion of respondents consuming vegetables on a daily basis exceeds the proportion of participants consuming vegetables weekly (z=1.99).

Rice, beans, *viandas* (root crops and plantain) and meat are the essential staples of the Cuban diet. In Cuba, if you have not eaten rice for the day you simply have not had food. By far the most popular meat is pork. In Cienfuegos, pig farming is a common practice. In apartment buildings, people have corrals in the parking lots where they raise pigs. It is also not unusual to observe chickens and rabbits raised in cages on people's patios and in backyards. The preferred mode of cooking is frying. Apart from being the traditional way of cooking, it is likely the most practical since many people have limited access to cooking units and fuel. The majority of the people cook with appliances that use natural gas or petroleum. For this reason cooking oil and lard consumption is relatively high. Most food is fried, including meats, *viandas* (except cassava that is boiled and garnished with a *mojito* comprised of oil, garlic and lemon juice), and fish. A typical Cuban meal would be composed of pork, rice and beans, some kind of *vianda* and possibly a lettuce and tomato salad (during the dry season). In the rainy season, string beans, okra and cucumber would be the preferred vegetables.

The diets of the cultivators from the La Calsada *organoponico* were typical Cuban diets rich in rice, beans, meat, fruits, tubers and vegetables (Table 4.2). One of them maintains that her family of 5 consumes 35 lbs of rice and 15 lbs of beans per month. Another states that he and his wife consume one pound of rice per day and one pound of beans per week.

Table 4.2 Diets of three cultivators

Food	C1	C2	C3	Food	C1	C2	C3
Beans				**Meat**			
• Red	√	√	√	• Beef	√		
• Black	√	√	√	• Chicken	√	√	√
Bread	√	√	√	• Lamb	√		
Rice	√	√	√	• Pork	√	√	√
Eggs	√	√	√	**Viandas**			
Fish	√	√	√	• Cassava	√	√	√
Fruit				• Plantain	√	√	√
• Banana	√	√	√	• Potato	√	√	√
• Chirimoya	√			• Sweet potato	√	√	√
• Guava	√	√	√	• Taro	√	√	√
• Mamey	√			**Vegetables**			
• Mango	√	√	√	• Cabbage	√		
• Oranges	√	√	√	• Cucumbers	√		
• Papaya	√	√	√	• Lettuce	√	√	√
• Soursop		√	√	• Radish	√	√	√
				• String beans	√	√	√
				• Tomato	√	√	√

According to all the respondents, the three most popular vegetables in Cienfuegos are lettuce, tomatoes and string beans. The top three vegetables consumed by the respondents during 1999 were also lettuce, tomatoes and string beans respectively (Table 4.3). The cultivators of the 11 organoponicos also indicated that the most popular vegetables in Cienfuegos were lettuces, tomatoes and string beans; hence they are the most cultivated crops in the city's urban gardens.

Table 4.3 Vegetables consumed in 1999 and general vegetable preference

Vegetable	% respondents that consumed vegetables in 1999	% respondents that like vegetables
Lettuce	100	100
Tomatoes	100	100
String beans	97.5	97.5
Cucumber	90.2	95.1
Peppers	90.2	92.6
Chives	83	83
Cabbage	80.4	92.6
Green onions	70.7	75.6
Okra	68.3	75.6
Beets	51.2	65.8
Radish	48	51.2
Cilantro	41.4	58.5
Chard	39	56.1
Carrots	36.5	63.4
Watercress	26.8	41.1
Parsley	19.5	24.3
Eggplant	17	24.3
Spinach	4.8	17.1

It is evident from the above table that although people expressed an affinity for a particular vegetable, not all of them consumed it in 1999. The difference in partiality to a particular vegetable versus actual consumption can be attributed in most cases to lack of availability. For example, 63.4% expressed that they enjoyed carrots while only 36.5% consumed carrots in 1999. When asked why, most respondents replied that carrots were hard to find. Only 2 out of the 41 respondents attributed lack of consumption of a vegetable to high prices, particularly those of beets, cucumbers and cabbage. Approximately 83% of the respondents replied they did not like spinach while 30% of them stated they were not familiar with spinach and had never eaten it.

According to the gardeners, spinach is popular in eastern Cuba but not in Cienfuegos. One of the gardeners began cultivating it when a woman from Santiago de Cuba requested it. He now grows spinach for a small group of regular customers (originating from eastern Cuba) that consume this green.

4.3 Factors of influence on dietary preference

The chi-square analyses indicated that there was no relationship of dependence between the type of food consumed (daily and weekly) and the variables of age (x^2=24.56) and family size (x^2=16.19) among the respondents (Table 4.4). We can therefore conclude that food habits are independent of the age and family size of the respondents.

Table 4.4 Results of chi-square test of independence for dietary habits

Chi-square Test	Computed daily x^2	Df	Critical x^2 values (=0.05)	Computed weekly x^2	Df	Critical x^2 values (=0.05)
Age vs. Food	24.56	36	43.77	11.82	28	41.34
Family size vs. food	16.19	35	43.77	11.19	16	26.3

The chi-square tests revealed that there was no dependence between vegetable preference and the age of the respondents (x^2= 19.26), or vegetable preference and family size (x^2= 18.32). There was no dependence between vegetable consumption and age of respondents (x^2= 25.2) or vegetable consumption and family size (x^2= 34.44) (Table 4.5). Thus we can conclude that vegetable preference and consumption are independent of the family size and the age of the interviewees.

Table 4.5 Results of chi-square test of independence for vegetable consumption and preference

Chi-square test	Computed x^2	Df	Critical x^2 values (_ =0.05)
Age vs. vegetable preference	19.26	64	79.08
Age vs. vegetable Consumption	25.2	56	67.5
Family size vs. vegetable preference	18.32	75	90.53
Family size vs. Vegetable consumption	34.44	70	90.53

4.4 Access to food

Food prices

Price is likely to be an important factor influencing the Cuban diet. Meat and cooking oil are the most expensive food items (Table 4.6). On the other hand, vegetables are relatively cheap especially those sold directly from the *organoponicos*. Vegetables are also sold in the open markets (*agromercados*) but at much higher prices. Most people therefore try to buy vegetables directly from the gardens.

Table 4.6 Prices of food sold in the free market and *Organoponicos* Cienfuegos-1999

Free market	Quantity	Price (pesos[10])	*Organoponico*	Quantity (lbs)	Price (pesos)
Rice	1 lb	4.5	Beets	1	1
Beans	1 l.	9	Cabbage	1	1
Milk	1 litre	5	Carrots	1	1
Eggs	Per unit	1.5	Chard	2	1
Oil	1 litre	40	Chives	1	2
Fruits	1 lb	0.5-2.5	Cilantro	1	3
Oranges	1lb	1.5	Cucumber	2	1
Papaya	1 lb	2	Eggplant	3	1
String beans	1 lb	2	String beans	1	1
Radish	1 lb	3	Radish	1	1
Tomatoes	1 lb	3	Tomatoes	1	1
Plantain	1 lb	2	Green Onions	1	1
Mango	1 lb	2	Lettuce	1	1
Fish	2.2 lbs	15	Okra	1	2
Tubers	1 lb	2-4	Parsley	1	4
Cassava	1 lb	2	Peppers	1	4
Sweet potato	1 lb	2	Spinach	1	1
Taro	1 lb	4	Watercress	1	1
Pork	1 lb	18			
Chicken	2.2 lbs	25			
Bread	Loaf	5			

In Cuba, people do not have access to all kinds of fruits and vegetables all year round as North Americans do. Their diets vary depending on the season. During the rainy season (April-September) the dominant vegetables are string beans, cucumber and okra while in the dry season (October-April) the most dominant vegetables are lettuce and tomatoes.

[10] In 1999, the exchange of 1 US dollar was 21 Cuban pesos.

Food rationing

The Cuban government provides food quotas that are distributed via the state food outlets known as "*bodegas*". Every member of a family is entitled to a fixed monthly ration of foods consisting primarily of rice, beans, sugar, coffee, and occasionally oil and meat (Table 4.7). Each household has a ration book or *libreta* that is distributed on an annual basis and used to collect the monthly quota. This food is heavily subsidized and thus it is relatively cheap. For children under the age of 7, the government provides a monthly quota of beef and milk. All children under the age of 7 are guaranteed one litre of milk per day. There are other foods that are occasionally available via the "*bodegas*" such as beef, pasta, yoghurt and wine. There is usually one *bodega* per neighbourhood complemented by the neighbourhood state bakery and butcher shop that occasionally distributes minced beef meat mixed with soya. Milk is not sold in the farmers' markets (*agromercados*), its distribution is limited through the *bodega* and only available to special groups such as children and the chronically ill.

The prices in the markets may be double or triple that of the *bodega* depending on supply and demand. For example, lettuce sold out of *organoponicos* or the *bodega* costs 1 peso per bunch whereas in the market it costs 3 pesos.

Table 4.7 Food quota per capita in 1999

Food	Quantity	Frequency	Price (Cuban pesos)
Rice	5 lbs.	Monthly	0.25 per lb.
Sugar	6 lbs.	Monthly	-
Chick peas	1 lb.	Monthly	-
Salt	1 lb.	Monthly	-
Cooking oil	_ litres	Monthly	0.40 per _ litre
Coffee	1 oz.	Monthly	0.5
Chicken	_ lb.	2-6 months	0.3
Eggs	8	Monthly	0.15 per egg
Fish	_ lb.	Monthly	0.5
Bread (whole)	1 loaf	Daily	1
Milk	1 litre	Daily for children under 7	0.25 per litre
Beans	1 _ lb.	Monthly	0.3
Pork	1 lb.	~6 months	15
Fruits	1 lb.	Varies	0.4-0.5
Plantain	1 lb.	Varies	0.4
Mango	1 lb.	Varies	0.4
Oranges	1 lb.	varies	0.5
Papaya	1 lb.	varies	0.4
Tubers	1 lb.	varies	0.4-1
Taro	1 lb.	varies	1
Cassava	1 lb.	varies	0.4
Sweet potato	1 lb.	varies	0.4

Alternative food outlets

Other sources of food are the infamous "dollar" stores also known as "*chopin*" from a Cubanised word of the English word for "shopping". One can buy goods in these stores only with US currency. Meat, eggs, dairy, cooking oil, pasta, mayonnaise, canned goods, cookies, chocolate and other luxuries are available in the "dollar" stores but are relatively expensive. Alternatives to the "dollar" stores are the "*mercaditos*" or supermarkets where people can buy goods with Cuban pesos. Goods such as soya yoghurt, luncheon meats, chicken and occasionally chocolate and pasta are sold. These shops tend to be under stocked in comparison to the "dollar" stores. There are specialized state food outlets that also sell fish and only accept Cuban currency. Three "*peso*" supermarkets, two fish markets and two major *agromercados* were located in the central part of the city. There were at least a dozen "dollar" stores that also sold food. Finally, another very popular source for food is the Cuban black market. Eggs, cheese, powdered milk, wine, beef, ice-cream and most food items are available on the black market but albeit not on a regular basis.

4.5 Nutrition

According to the three specialists the Cuban diet is primarily deficient in animal protein and calories. All three mentioned some mineral and vitamin deficiencies such as vitamins A, calcium and vitamin B12, but these were not significant. Prior to the Special Period, it was argued that Cubans enjoyed one of the highest caloric intakes in Latin America. In reference to the Special Period one of the interviewees stated that:

> *Up to 1993, all Cubans, who amount to 11,000,000, received a minimum of 3,500 calories per day including 90 grams of protein (mostly of animal origin). A substantial amount of calories was obtained from animal fat and a sufficient amount of vitamins that was well above the minimum requirements. The Special Period was a total crisis, unforeseen in a society that was previously well nourished.*

One of the interviewees maintains that prior to the Special Period, the Cuban diet was rich in nutrients especially protein:

> *The minimum daily intake for protein is 60-70 grams and we had an average daily intake of 90 grams. The source of protein was fundamentally animal based, as other sources of protein such as soya and other vegetables were not introduced until much later. Alternative sources of protein were not too popular and even now animal protein remains the preferred choice*

A significant portion of the calories was derived from imported foods provided by the USSR. Another interviewee stated that "*before the Special Period there was great support from the Socialist Block and thus there were many canned foods. These were not good for our health.*" The Special Period resulted in significant food reductions especially of animal protein, cooking oil and milk. One of the professionals stated that:

> *When the Special Period began, oil and meat disappeared and you could only live on rice and beans. The nutritional level decreased and diseases such as neuritis and polyneuritis appeared. The state distributed free vitamins to everyone.*

In reference to the infamous 1993 epidemic that affected thousands of people, one of the specialists commented that:

> *In 1993, nutritional factors affected more than 50,000 Cubans. It manifested itself as damage in the optic nerve and has been the largest epidemic in the world concerning this specific problem. There was vast research done by the international community. Here we experienced clear multiple vitamin deficiencies between the years 1992-1993. After 1993, vitamins were provided free of charge to the population especially children, pregnant women, the chronically ill and the elderly.*

Interviewees stated that the consumption of tubers, vegetables, and plantain increased as a result of the economic crisis. One of the interviewees stated that the Special Period introduced new foods to the Cuban diet:

> *The Special Period introduced soya beans and a more diverse choice of vegetables such as cauliflower and broccoli to act as supplements. Now even soya-based yoghurt seems to be accepted.*

Nutritional contribution of *organoponicos*

The cultivators of La Calsada maintain that the gardens have contributed to the diversification of their diet. One of the gardeners stated "*before the Special Period, very few people ate vegetables on a daily basis, and the organoponicos have helped educate the people*". In 1993, when the food situation in Cuba was in its most critical stage, the cultivators of La Calsada were not selling all of their crops because people simply were not familiar with them and thus would not buy them. They indicated that crops such as chard, celery, eggplant, cilantro, cabbage and radish were not well known prior to the economic crisis. According to the manager, before 1989 people ate many canned foods imported from the USSR, since the Special Period people have been forced to eat more vegetables and tubers.

All of the *organoponicos* had signs advertising the nutritional benefits of their products. In a few of the gardens, nutritional fact charts were displayed outlining vitamin content of the different crops. The administrators of the gardens demonstrated significant knowledge of the nutritional contents of their crops. When asked which were the most nutritional crops in terms of vitamins A and C, they singled out carrots, tomatoes, spinach, parsley and beets. String beans were also praised for their high iron content.

During the interviews with the garden patrons, 92% (C.I. 82%-100%) responded that the *organoponicos* have improved their diets. Approximately 73% of the respondents claimed they consume more vegetables now than before the Special Period (C.I. 60%-86%). Approximately, 44% of the respondents are purchasing vegetables daily (C.I. 29%-59%), while 44% (C.I. 29%-59%) are purchasing vegetables weekly. Only 12% of the participants are purchasing vegetables monthly (C.I. 3%-21%). When asked whether an *organoponico* is located near their house, 92% (C.I. 82%-100%) responded in the affirmative. In Cienfuegos, each neighbourhood has at least 1 and as many as 21 *organoponicos.* It was estimated that the average distance a person would need to travel to get to their neighbourhood garden would be 300 metres (pers. com. Socorro 1999). Only 7.3 % (C.I. 6.2%-7.8%) responded they considered it difficult to obtain vegetables in Cienfuegos.

Impressions of experts

All three specialists agreed that urban gardens have made significant contributions to food security and the improvement of people's diets during the Special Period. One of the respondents stated:

> *Yes they have helped us a lot. There are those who are opposed to them, however the gardens have made goods available to the general public and have provided solutions to nutritional and health problems. I have a good impression of the urban gardens, I hope they continue.*

The same respondent added that Cienfuegos produces the highest volume of vegetables per capita at approximately 405 gr. per capita per day. Two respondents maintained that although the gardens have improved food security, production was not meeting the needs of all the people:

> *Urban agriculture has contributed but it is not enough for everyone. They say that there are over 300 gr. per person per day but I have not been able to buy much because there is none. The organoponicos are very beneficial but how can I tell you… it is difficult at times to acquire vegetables.*

Main findings of dietary study

These results indicate that the diet in Cienfuegos is primarily composed of rice, beans, *viandas*, and vegetables. The participants of the survey are consuming a higher proportion of vegetables in relation to dairy, eggs, fruits and meat. The Chi-square tests of independence did not reveal any relationship between age and family size of participants and food consumption and vegetable preference. Food in Cuba is distributed through the ration system, farmer's markets, government food outlets, urban gardens and the black market. Prices vary among the different food distribution systems. The majority of participants (73%) stated that they consume more vegetables now than prior to the Special Period and 92% feel that the *organoponicos* have improved their diet. The nutrition experts maintain that the Special Period has led to the diversification of the Cuban diet and that urban agriculture has made significant contributions to people's diets.

CHAPTER 5
DISCUSSION AND CONCLUSIONS

The first part of this chapter contains a discussion of the status of the *organoponicos* in relation to the definition of "organic" agriculture that was established in the introduction. It will be argued that the cultivators of the *organoponicos* practice a form of ecological agriculture that although it does not comply with all Canadian organic certification criteria, it is "functionally organic" since the major flows in the system are organic. Two strategies will de discussed in relation to potential future directions of these systems. If the Cubans decide to cater to a certified organic market then some changes would have to be made in practices to meet certification standards. On the other hand, the Cubans may wish to concentrate on a strategy that places less emphasis on purity of inputs and more on the self-sufficiency of the system.

In the second part of this chapter, the contributions of the *organoponicos* to people's diets in Cienfuegos are discussed.

5.1 Organic status of the *organoponicos*

It must be stressed that the Cubans are not currently seeking organic certification of the *organoponicos*. According to Morin (1998) and Holtslander (2000), the Cubans are in the process of developing certification standards for agricultural products but these have yet to be finalised and implemented. The following analysis may be a useful source of information for the developers of such standards in Cuba.

External inputs

Organic certification places a lot of emphasis on the "organic" purity of the external inputs used in production. Standards for example, emphasise the prohibition of soluble fertilisers and genetically modified organisms. The standards include a list of permitted substances while a comprehensive list of prohibited substances is provided by the Organic Materials Research Institute (OMRI) (CGSB 1999; OMRI 1998). Certain aspects of the *organoponico* operations are in clear violation of organic standards pertaining to external inputs, namely the use of prohibited pesticides and fertilisers. In all 11 *organoponicos*, usage ranged from at least 2 prohibited substances to as many as 9 (Appendix G). According to Sanchez (1999), in 1998, 78% of the organoponicos surveyed in Cienfuegos were using mineral fertilisers while 62% were using chemical pesticides.

Generally, in Cuba there is a movement by regulators and academics towards abolishing all “chemical inputs”, but this has yet to be achieved. Much of the literature surrounding urban agriculture in Cuba has focused on Havana where the use of synthetic fertilisers and pesticides is prohibited within city limits (Altieri *et al*. 1999; Murphy 1999). This is not the case in Cienfuegos, where the use of chemical inputs is not entirely prohibited but it is regulated by the state. As was reported earlier there is a list of permissible substances that the state allows in *organoponico* production. If a gardener is observed using a prohibited substance, they may be fined. In 1995, the Cuban Ministry of Agriculture published a technical guide for *organoponico* production, which recommends integrated pest management that incorporates the use of chemical pesticides (Ministerio de Agricultura 1995). Extension workers in Cienfuegos were using this guide at the time of the study.

The La Calsada *organoponico* was using at least 4 agrochemicals that are prohibited under Canadian organic standards. *Tabaquina* is an example of an innovative natural pesticide that the Cubans have developed to combat insect infestations. However, under an internationally recognised organic production scheme this would be forbidden (OMRI 1998). Another common practice in all of the gardens that were visited is the use of carbaryl (a prohibited carbamate) to treat seeds, especially small ones such as lettuce seeds. The cultivators claimed that ants would carry away the seeds if they did not treat them with a chemical deterrent. In terms of fertilisers, the manager of La Calsada mentioned that he occasionally sprayed urea to boost the growth of the crops. Even though the application of this substance is sporadic, this practice is in violation of organic standards.

There was however, no evidence of GMOs being used in the *organoponicos.* This could change in the next few years, unless preventative standards are established, as biotechnology is the third largest industry in Cuba after sugar and tourism Cuba is allegedly the most advanced country in Latin America in terms of genetic engineering (Rosset and Benjamin 1994). According to one source, Cuba is developing a range of genetically modified crops, 85% of which are aimed at the domestic market but are not expected to reach the marketplace for at least two years (Lehmann 2000; Farmers Union Editorial: Biotechnology News). Preventing the spread of GMO technology in food production is an important issue especially as it relates to organic agriculture.

Principles of soil fertility

Organic agriculture emphasises the maintenance of fertile soil through practices that enhance organic humus levels, balance nutrients and stimulate biological activity in the soil (GCSB 1999). Related standards discourage the import of off-farm organic matter including compost and manure, under the premise that in a balanced organic system off-farm organic matter should act as a supplement to on-site nutrient cycling within the farm (Lampkin 1999 pg. 120). The *organoponicos,* however, are heavily dependent on off-farm sources of organic matter (either manure, compost or sugarcane filtercake); in fact the most commonly cited problem in the garden is the lack of sufficient organic matter.

According to Lampkin (1999 pg. 70), ideal organic holdings are "balanced" in that they are self-sufficient in terms of nitrogen. Systems that are more heavily dependent on purchase of external fertility inputs to compensate for imbalances are referred to as "exploitative". . Examples of "balanced" operations are likely to be found in mixed arable/livestock holdings while horticultural operations are likely to be "exploitative". The reason for this is that mixed operations tend to be more self-sufficient in the sense that animal wastes are used as inputs in crop production whereas pure horticultural operations must import fertility inputs from outside sources. The organic standards for the Soil Association in Britain make allowances for the import of non-organic off-farm manures and plant wastes for intensive horticultural systems (Lampkin 1999 pg. 633). This exception is made in the case of intensive horticultural systems because it is recognised that adequate nutrition of the crops is not always possible by on-farm methods (crop rotations, on-farm composting etc.) alone.

The *organoponicos* are horticultural operations that fall under the "exploitative" category. Therefore, exceptions could be made regarding the source of the organic matter.

For this reason, the standard regarding off-farm compost and organic matter was considered non-applicable in the *organoponico* context.

The fact that these operations are importing significant amounts of organic matter raises concerns regarding nutrient imbalances. Manure is often excessive in phosphorus and deficient in potassium relative to nitrogen concentrations and crop requirements. Long-term applications of manure are known to increase soil phosphorus especially as phosphorus forms insoluble complexes with cations (Lampkin 1999 pg. 78). On the other hand, potassium is easily leached out of manure and compost while it is less likely to be leached out of the soil because it is a monovalent cation that is held firmly on the cation exchange complex (Lampkin 1999 pg. 72). Studies conducted on 26 organically managed farms indicated that potassium contained in manure and compost is highly water-soluble and thus susceptible to runoff (Berg 1990 in Nolte and Werner 1991). Long-term applications of compost and manure might therefore lead to phosphorus overloading and potassium deficiencies.

Although all of the managers cited organic matter as the number one constraint in the *organoponico* operations the results of the nutrient limitation experiment in La Calsada did not indicate any significant differences between the mean yields of the treatments. The leaf tissue analyses demonstrated that the lettuce was sufficient in nitrogen, phosphorus and potassium for both the first and second harvests. Furthermore, the soil analysis indicated that the soil had excessive levels of both phosphorus and potassium. Thus there was no evidence to suggest any significant nutrient limitations in La Calsada. This is not surprising, as at least 70% of the bed is comprised of organic matter in the forms of composted manure and *cachaza.*

In organic operations efforts are made to achieve as much self-sufficiency in nutrients as possible (Nolte and Werner 1994). One of the main objectives of the soil management program of organic systems is to “promote an optimum balance and supply of nutrients” (CGSB pg.8). Nutrient budgets provide a means to assess major nutrient removals from the system and the need for replenishment (Lampkin 1999 pg. 84). Ultimately, nutrient budgets serve as rough guide for surveying nutrient cycling within agricultural operations. Rough calculations of nitrogen input suggest that inputs in La Calsada are more than adequate to satisfy nitrogen requirements (Table 5.1).

Table 5.1 Rough nitrogen budget for La Calsada *Organoponico*

The major inputs in the La Calsada *organoponico* were:

1. **Sugarcane filtercake**: approximately 50 cubic meters per year are applied to 1000 m^2 of container beds and approximately 250 m^2 of raised beds. Assuming a bulk density of 0.3 and N content of 1.1% (figures cited in Patriquin, 1982), then the N application to the container beds is 138 gN/m^2.

2. **Worm Compost**: approximately 3 kg per m^2 per year. Assuming a bulk density of 0.3 and N content of 1.5%, this amounts to 13.5 g N/ m^2.

3. **Urea**: applied on lettuce approximately 150 g of urea in 16 litres of water are sprayed on crop. It was estimated that the crops are sprayed approximately 10 times a year. This amounts to only 1.4 gN/m^2.

The total inputs amount to **153 gN/m^2**.

Outputs: The output of fresh produce is approximately 27 kg/m^2 per year. Assuming 0.2% N on a fresh weight basis, (Anonymous 1981) this amounts to **54 gN/ m^2**.

In 1999, the total inputs, were 153 g N/ m^2 and the outputs amounted to 54 g N/ m^2. These are very crude estimates, however even allowing for two-fold error, they suggest that nitrogen supplies are adequate. A more refined budget might reveal excess nitrogen. These results concur with the results of the nutrient limitation experiment, leaf tissue and soil analyses.

It must be acknowledged that the nutrient limitation experiment only examined one out of the 31 container beds in the *organoponico.* Each container bed has a relatively unique substrate profile because it was filled with organic matter from various sources and at varied rates, therefore it is not possible to determine potential nutrient limitations of the whole system by just examining one of the container beds. More refined nutrient budgets would offer a better indication of major nutrient inputs and removals. The import of organic matter in these systems facilitates the recoupling of the nutrient mineralization and uptake systems (Patriquin 1993). The removal of crops from sites of production is regarded as a form of spatial decoupling whereas recoupling takes place through recycling and importing soil amendments. Often there are difficulties in the synchronisation of the nutrient-supplying and plant uptake systems that can lead either to nutrient limitations or excesses in nitrates resulting in nitrate leaching, weed and pest infestations, and toxic levels of nitrates in plants (Patriquin 1993). For future studies, a longer period of time would have to be dedicated to record the amounts of soil amendments entering the gardens and the quantity of crops leaving the system, to calculate a more accurate nutrient budget.

The *organoponico* operations are heavily dependent on peri-urban and rural agricultural production for soil amendments and, in the case of Cienfuegos, on the manure produced in the city by horse pulled transportation. Apart from the obvious benefits of reduced pollution and income generation, horse drawn buggies also contribute to garden fertility and therefore food security. Since it is illegal for the horses to litter the streets, the manure is collected and deposited in designated locations around the city. After the manure is composted it is utilised by the gardeners as a fertiliser. In Cienfuegos there are approximately 166 horse drawn buggies producing about 1 ton of manure a day. This is a mutually beneficial relationship as the gardens receive added fertility while the owners of the buggies enjoy free treatment of their wastes.

This dependency on outside sources of fertility must be taken into consideration if the long-term viability of the gardens is to be realised. Cuba is embracing organic methods on a national scale out of necessity (Benjamin and Rosset 1994; Altieri *et al.* 1999; Warwick 1999). If organic agriculture becomes the preferred mode of agriculture in Cuba, rural farmers in an effort to minimise external inputs would focus on recycling nutrients within their own systems making residuals (*cachaza*) and by-products (manure) unavailable to other operations. This scenario combined with a possible future decline in horse drawn transportation in Cienfuegos would have detrimental effects on the ability of the urban gardens to maintain adequate soil fertility.

The replacement of the horse by the motor was one of the factors that led to the decline of the “marais” urban agroecosystem of nineteenth-century Paris (Stanhill 1977). The essential feature of the “marais” system was heavy dressings of stable manure that provided fermented “hotbeds” on which out-of-season crops were produced under the protection of glass sheets (Stanhill 1977). With the loss of their primary fertility source the gardens rapidly declined in the first quarter of the 20^{th} century.

Another issue that must be considered for operations that import compost and manure involves *E. coli* 0157 and other zoonotic pathogens. This strain of *E. coli* is pathogenic and can lead to a serious life threatening condition known as hemolytic-uremic syndrome (HUS) that commonly occurs in children under 5 and the elderly (Patriquin 2000). One pathway for infection is through food grown in manure fertilised gardens. For this reason, the cultivators in the *organoponicos* should take extra caution when using manure as a fertiliser. Patriquin (2000) offers some provisional guidelines for reducing the presence of E. *coli* 0157 on farms. These include ageing raw manure for at least one year before use and allowing compost to cure for 2-4 months after the heating phase (exposure to $55\text{-}60^{o}$ C for at least 15 days and turning the pile at least 5 times). When handling fresh manure, precautions should be taken such as wearing protective clothing and washing after handling manure. All of the cultivators claimed that they either composted or aged the manure for at least a few months before they applied it to the gardens.

5.2 Contamination issues

Heavy metals

Another issue addressed in the standards is the potential compromise of organic integrity via unintentional exposure to prohibited substances (CGSB 1999). This issue is important especially in the urban context as potential sources of contamination surround the gardens. Lead contamination of soil is one of the most commonly cited problems in urban areas (Mielke 1999). The results of the heavy metal soil analysis of the La Calsada *organoponico* indicated that lead was present within acceptable limits at an average of 15.6 mg/kg. The Canadian Soil Quality Guidelines recommend that lead not exceed 70 mg/kg for agricultural lands while for compost the limit is set at 150 mg/kg (Canadian Environmental Quality Guidelines, 7 Apr. 2001; CCME 1996). Due to the combination of soil and compost that is used in the *organoponicos* both guidelines are being considered. For both sets of guidelines the amount of lead found in the La Calsada *organoponico* was well below the guideline. This is promising as the La Calsada *organoponico* is located on a heavily used road in the city where the potential for lead contamination is greater.

The heavy metals that were close to exceeding Canadian guidelines were copper and zinc. This is not surprising as copper and zinc are among the most prevalent heavy metals found in composts (Jeliazkov and Warman 1999). Copper was present at average levels of 94.6 mg/kg while zinc was present at an average of 324 mg/kg. For agricultural lands the recommended maximum in Canada for copper concentration is at 63 mg/kg while for type A compost it is set at 100 mg/kg (Canadian Environmental Quality Guidelines, 7 Apr. 2001; CCME 1996)[11]. On the other hand the European Community has set a higher maximum soil concentration at 140 mg/kg while the Soil Association of the U.K is much lower at 50 mg/kg (Lampkin 1999). The levels present in La Calsada are on average above those recommended in Canada for agricultural land but lower than those for compost. Copper is controversial because of its potential toxicity for plants and contamination of the food chain (Jeliazkov and Warman 1999). Excess in copper can lead to chlorosis and cause iron deficiency in plants (Pique *et al.* 1996). It is important to note that copper availability to plants depends on a number of factors including soil type, pH, the crop grown and the presence of mychorrhizal fungi. Copper uptake of plants is enhanced at a soil pH solution of 5-6 (Jeliazkov and Warman 1999). From the soil test conducted in the experimental container bed the pH of the substrate was above 7 indicating unfavourable conditions for copper uptake. The relative alkalinity of the substrate is likely due to the high ratio of organic matter to soil present in the container. Although the containers are not homogeneous in their soil profile they are made up of high levels of compost and *cachaza* that are likely to increase the pH.

Similar observations were made regarding zinc. On average zinc content at 324mg/kg was much higher than the recommended 200 mg/mg for agricultural lands but lower than the 500 mg/kg for the compost (Canadian Environmental Quality Guidelines, 7 Apr. 2001; CCME 1996). According to Lampkin (1999 pg. 121), the European Union has established a maximum soil concentration for zinc at 300 mg/kg while the Soil Association

[11] Type A compost refers to high quality compost that can be used for all types of application including agricultural lands, residential gardens and horticultural operations (CCME 1996).

is stricter at 150 mg/kg. Excess of zinc also produces chlorosis in plants (Jones *et al.* 1991).

Obviously the guidelines vary among countries and organisations, and differ for soil and soil amendments. The Cubans should consider establishing guidelines appropriate for this type of cultivation where a high volume of compost is being used as the growing medium. The stricter guidelines established by the Soil Association are noteworthy. It appears that these organic standards tend to err largely on the side of caution. Nevertheless, there is controversy surrounding the validity of the current soil guidelines because they are based on the total content of heavy metals in the soil. The criticism stems from the notion that only a small amount of total metal content in the soil is available for plant uptake or mobile enough to pollute groundwater (Petruzzelli 1989). Nutrient absorption by plants takes place in soil solution hence the amount of soluble heavy metals is more significant than the total content (Petruzzelli 1989).

More recently Jeliazkov and Warman (1999) recommended that different guidelines be developed and based on the crop being grown, soil type, bioavailable trace element content and the results of long-term field experiments.

Contamination from neighbours

To deal with unintended contamination by prohibited substances, organic standards recommend that cultivators establish buffer zones. The CGSB (1999) has not established buffer zone specifications. Rather it is left up to the certification bodies to set guidelines according to local needs and conditions. The Organic Crop Improvement Association (OCIA) recommends that buffer zones be at least 25 ft (8 m) (OCIA 2000).

The urban gardens are vulnerable to inadvertent contamination especially as they are located in areas of high human activity. The concept of buffer zones developed out of the concern that neighbouring farmers in rural areas may be spraying prohibited substances. This scenario is also applicable in the urban context, especially in cases where you have *organoponicos* bordering other farming operations. For example, the La Calsada *organoponico* borders an intensive urban garden (*huerto intensivo)* where prohibited substances might be used. The *huertos* also practice organic techniques such as crop rotations and composting and IPM. According to Sanchez (1999), in 1998, 100% of the *huerto* cultivators surveyed in Cienfuegos used chemical pesticides while 70% used mineral fertilisers. If the Cubans are interested in attaining organic certification, buffer zones will have to be established for gardens where inadvertent contamination may be an issue. Mosquito fumigation practices would also have to be taken into consideration.

Production plan and records

Two of the most important elements of organic agriculture are the production plan and record keeping. The producer is required to maintain production plans and records that will enable the certification body to establish whether the operation adheres to the standards. Fundamentals of the production plan include a detailed map of the enterprise and a description of the rotation plan. Under the standards producers are required to maintain records of inputs and production sufficient to establish an audit trail. In all 11 organoponicos production plans and records were lacking. For these operations to be certified according to Canadian organic standards, production plans and records would have to be developed and maintained. This would not be difficult as Cuba has a 95% literacy rate and the Enterprise could facilitate the establishment of production plans and record keeping requirements for the *organoponico* operations.

Audit trail

Another important element of organic agriculture is the audit trail. An audit trail is the documentation that allows tracking a product from the place of production to the market (COG 2001). Audit trails became a necessity with the development of impersonal food distribution systems while it is less of an issue for food that is being sold directly from the operation as in the case of *organoponicos*. All of the *organoponicos* lacked the production records required for a proper audit trail. In the case of La Calsada, there were no production records apart from the documentation of the amounts of produce sold per day that the manager submits to the Enterprise monthly.

***Organoponicos* are "organismically" organic**

> *Sustainable agriculture must be economically viable for all participants in the food system; it must be socially just and supportive, it must be ecologically sound, and it must meet the needs of today's population in all countries, without jeopardising the needs of future generations.*
>
> Hart Haidn, March 27, 2000 (cited in COG 2001 pg.5)

It can be argued that the operators of *organoponicos* in Cienfuegos are practising an alternative form of agriculture that even though it cannot be defined as "organic" from a Canadian certification standpoint, it is "functionally organic" in that the major flows in the system are organic and it is ecologically sound.

The term organic agriculture for many has come to mean chemical-free agriculture. There is no doubt that this is an important element, however organic agriculture means much more than that. As was so well put by Merrill (1983 pg. 183), the term "organic" "conveys meanings which are more accurately described by organicism and organism". In organic agriculture the farm or operation is perceived as an organism or system where all life is inextricably related. It is a holistic approach that seeks to develop productive agroecosystems that function harmoniously with the environment.

Ecofarming is a form of organic agriculture that places more emphasis on the 'organismal' aspects of production than on the purity of inputs. Ecofarming is defined as a form of agriculture that depends on local resources to achieve sustainability and utilises low levels of external inputs (Kotschi *et al.* 1990). The term "ecological" relates to an evolving process where changes in the ecosystem must invariably be assessed to determine whether specific measures are of value. Ecofarming avoids the use of the terms "ecological and unecological" rather it assesses the degree of appropriateness of a farming technique for a specific site and time. This form of agriculture makes optimal use of on-farm and renewable resources in order to mitigate degradation, improve the environment and achieve high and sustainable levels of production. This farming approach focuses on the cyclic flow of mineral nutrients, high rates of biomass production and species diversity

(Wagstaff 1987). Ecofarming aims to achieve high and long-lasting biomass production while maintaining or restoring a balanced ecosystem at a given site. The techniques utilised to achieve this include but are not limited to the following: multiple cropping, use of biological symbionts, green manuring, mulching, composting, and integrated pest management (IPM) (Kotschi *et al.*1990).

The *organoponicos* examined in Cienfuegos were practising ecofarming techniques such as multiple cropping, composting, crop rotations and Integrated Pest Management (IPM). This form of urban agriculture makes use of on-farm (crop residues and worm compost) and renewable resources (manure and sugarcane filtercake) while discouraging reliance on chemical inputs. Since the *organoponicos* were developed in response to an economic crisis, they have focused on making optimal use of resources for the purpose of feeding the Cuban people. As the economic situation changes and food security becomes less of an issue, the Cubans may wish to consider making optimal use of on-farm and renewable resources with the objective of ameliorating the environment and making their food production system more ecologically sustainable.

In regards to biodiversity, the urban gardens have made contributions simply by converting unused parking lots into areas of high agricultural biodiversity. With at least 15 different crops, medicinal plants and condiments, the gardens have transformed many urban areas and helped revive traditional crops such as passion fruit and custard apples (Murphy 1999). The *organoponicos* may not be acting as important wildlife refuges, nevertheless they act as habitats for many insects and birds.

The majority of the *organoponicos* in Cienfuegos are 7 to 8 years old and although no significant nutrient limitations were observed in La Calsada it cannot be concluded that these are balanced systems. More accurate nutrient budgets and long term monitoring would have to be practised to better assess the appropriateness of the farming techniques in the *organoponicos*. The Cubans may want to consider the benefits of mulching, green manuring and the cultivation of legumes for building up fertility and soil structure and reducing reliance on the import of external fertility inputs. The incorporation of more legumes into the system would be an advantage given that the soil tests indicated that both phosphorus and potassium were present in high levels. Planting legumes is a way to fix atmospheric nitrogen into the soil without adding phosphorus and potassium into the system.

The *organoponicos* are engaged in intensive vegetable production and are producing high levels of biomass while treating wastes and recycling nutrients. The intensity of this form of agriculture demands higher technological and organisational precision than rural farming and must be carefully monitored to protect the environment and public health (IDRC Program Initiatives, 2 Dec. 2000). Plants that readily take up nitrates such as lettuce and spinach can potentially be harmful to human health if excess nitrates are present in the soil. Plants that do not immediately utilise nitrates in protein formation store excess nitrates in the cells that can combine with amines to form carcinogenic substances when cooked or ingested (Lampkin 1999 pg. 565).

The *organoponicos* are performing valuable ecosystem services (Costanza *et al.* 1997) by treating wastes (manure and *cachaza*) and producing food for human consumption. The manure from livestock farms and the plant residuals from the sugarcane production are the main fertility inputs for these urban systems. On one hand, the urban farms are acting as waste treatment centres for the rural production systems but on the other hand fertility is being removed from the rural areas. In the long run, this may not be sustainable unless both rural and urban agricultural systems become more self-sufficient in terms of soil fertility and waste treatment. This could be achieved by creating mixed systems through the incorporation of livestock. If such an approach were pursued public health risks would have to be taken into consideration and appropriate measures taken. In the past few years there has been an increase of rural zoonotic diseases in urban areas (Flynn 1999).

The other option would be to supplement rural production with some synthetic fertilisers to make up for the lost fertility due to organic matter exports. This is a scenario where organic integrity in the rural areas would be compromised in order for the urban systems to become more sustainable in the long run. Another option would be to set up a municipal composting program for the livestock manure produced in households. Currently all the food scraps produced in Cuban homes are fed to pigs and chickens that are being raised in backyards, balconies and gardens. Many Cuban families raise livestock due to food shortages and high prices of meat. In most cases the manure is washed into the municipal sewer system that leads into the harbour.

Finally, if the Cubans' main concern is food security then another option would be to use municipal sewage sludge even though organic agriculture does not permit its use as compost material (CGSB1999). In 1999, the city of Cienfuegos produced approximately 300-400 m^3 of solid waste (Suarez 1999). Municipal sewage sludge could be composted and used in the urban food production systems thereby reducing the need to import manure from rural areas while providing a steady supply of organic matter. Regardless of whether these systems are "organic" or not, they would have to be carefully monitored to protect the public health. If sewage sludge was used as a fertility input the measures would have to be taken to monitor the levels of heavy metals, nitrates and other potentially harmful contaminants in the soil.

In the larger scheme of things, the gardens are making contributions to reductions in airborne pollution by reducing the amount of transport required for importing food from overseas and transporting local foods from rural to urban areas. For future studies, it would be interesting to calculate the environmental costs saved by not importing food from overseas and transporting food from rural to urban areas and compare it to the costs of transporting organic matter from rural to urban areas. In the case of La Calsada, in 1999, approximately 10 truck-loads of organic matter (amounting to 50 m^3) were used as inputs and on average 27 tons of food were produced. It is not only a matter of how many truckloads are required for transport. The organic matter that is being delivered to the urban gardens of Cienfuegos originates from peri-urban and rural farms within the province whereas food in many cases has to be transported from other provinces and other countries. The advantage of the *organoponicos* is that they sell fresh products right out of the garden whereas imported food not only has to be transported but also packaged, stored and refrigerated before it reaches its destination.

In the socio-economic realm, the *organoponicos* are making significant contributions by enhancing food security and providing the income of several families while offering educational opportunities and enhancing the aesthetics of urban areas. La Calsada provides the main income for four families. The cultivators in Cienfuegos are making on average 600 pesos a month, an amount that is significantly higher than the average salary of 200-360 pesos. According to Socorro (pers. comm. 1999), the cultivators in Cienfuegos are making between 30 and 50 Cuban pesos per square meter of garden. Government figures estimate that 117,000 Cubans work in urban agriculture and 26,426 workers are employed in jobs related to urban farming (Gonzalez and Murphy 2000).

There is no doubt that these gardens have contributed to improving food availability during the Special Period (Murphy 1999; Chaplowe 1998; Altieri *et al*. 1999). Nation-wide the production of vegetables in urban agriculture has increased steadily from 4,213 tons in 1994 to 681,818 tons in 1999 (Socorro 1999). According to one source, urban agriculture in 1999, produced 65% of Cuba's rice, 46% of fresh vegetables 38% of non-citrus fruits, 13% of root crops and 6% of eggs (Kjartan 2000). Urban agriculture has also made significant contributions to people's diets. This will be addressed in the second part of the discussion.

From an educational perspective, the *organoponicos* are making significant contributions by serving as outdoor classrooms for high school and agronomy students. The La Calsada *organoponico* was hosting three regular students and was visited by high school students during field trips. The gardens also act as information sites by displaying posters on the nutritional value of crops. Furthermore, the *organoponicos* have the potential to provide opportunities for recreational activities through the development of agro-tourism. La Calsada is one of the urban gardens regularly visited by tourists interested in the Cuban urban agriculture movement.

Potential for organic certification

Certified organic agriculture has great potential in Cuba because of governmental support and the infrastructure that currently exists. Extensionists visit the urban gardens weekly and are committed to helping farmers overcome difficulties and practice ecological agriculture. Furthermore, several Cuban agricultural research stations have focused their efforts on developing ecological methods. For example, the Plant Protection Research Institute (INISAV), which heads 14 provincial laboratories, 60 regional plant protection stations and over 200 Centres for the reproduction of Entomophages and Entomopathogens (CREEs), develops biological control agents for the rural and urban food production systems (Murphy 1999). The Enterprise holds annual seminars and workshops providing an ideal forum to support cultivators make the transition to organic.

If the Cubans desire to expand into export markets or are interested for example, in selling organic foods to the local tourist industry they would have to adopt a set of internationally recognised organic standards. On the other hand, if the primary concern is food security, then ecological aspects such as self-sufficiency take precedence.

Current practices of the *organoponicos* in Cienfuegos are not entirely in compliance with the minimum Canadian organic standards, hence these systems cannot meet the Canadian definition of “organic”. If in the future the Cubans desire to certify their products as organic they would have to develop standards and a certification process that take into consideration local conditions and unique agricultural production systems such as the *organoponicos*. With relatively few changes in practices the *organoponicos* could qualify for organic certification by pursuing the following.

1. Phasing out all chemicals that are not permitted in organic agriculture. The use of all of the pesticides rated as prohibited, such as carbaryl, thiodan and synthetic fertilisers such as urea would have to be discontinued. Nicotine is another substance that is prohibited, therefore the use of *tabaquina* as an insecticide would not be allowed.

2. Establishing a production plan and record keeping system for the cultivators that would be easy to implement and sufficient to establish the necessary audit trail.. According to the CGSB (1999), the production plan should include a detailed map of the operation, a description of the rotation and production plan, a detailed description of the sources of seed, a description of the fertilisation program, and a detailed listing of all production inputs with justification for their use.

3. Documenting potential sources of contamination by prohibited substances or other pollutants and concerns associated with neighbouring areas. In areas where there are risks for contamination from neighbouring areas, sufficient buffer zones should be established. These would have to be described in the production plan and included in the map of the gardens.

4. Reducing reliance on external fertility inputs. It is acknowledged that these systems rely heavily on the import of organic matter from peri-urban and rural farms; nevertheless, more emphasis needs to be placed on building soil fertility within the system through organic techniques such as crop rotations, inter-cropping, mulching and green manures.

5. Ensuring that genetically modified organisms are not used in these food production systems.

6. Establishing Cuban compost quality standards. According to the CGSB (1999), compost production should follow federal and/or provincial compost standards for maturity, pathogens, heavy metals, and foreign matter.

7. Taking measures to monitor soil quality. The CGSB (1999) recommends annual soil tests to monitor soil organic matter, pH, macro and micronutrient levels, and cation exchange capacity especially when soil deficiencies are in question.

8. Taking measures to monitor the quality of irrigation water, particularly if there are potential sources of contamination from prohibited substances upstream.

9. Producing annual seedlings and transplants in accordance to the standards. Perennial plants propagated from perennial stocks can be obtained from non-organic sources, but the products from such plants can be labelled and marketed as organic only after a 12-month period of cultivation in compliance with organic standards has expired (CGSB 1999).

The Cubans may wish to consider taking advantage of the food wastes produced by the tourist industry by returning this valuable source of nutrients back into the food production systems. Although there are some *organoponicos* that cater exclusively to the tourist industry, there has been no documentation of food gardens operating within tourist resorts. Just as the Cuban factories have their respective *autoconsumos*, the government might consider establishing gardens in the resorts. These operations could produce food for the guests, recycle organic wastes and act as an attraction.

Some areas that would benefit from further research that were identified during this study involve the following.

1. To determine whether the *organoponicos* in other parts of Cuba operate under the same rules and regulations;
2. To examine how organic certification would impact the livelihoods of the rural and urban farmers;
3. To consider alternative fertility inputs such as green manuring, and the incorporation of more legumes;

4. To study the public health risks associated with raising livestock in urban areas;

5. To calculate the environmental costs accrued by importing and transporting food and compare it to the costs of transporting organic matter from rural to urban areas;

6. To conduct studies on the social aspects of urban farming. In Cienfuegos, many of the farmers are over 50 years old and most of them are men. It would be beneficial to investigate the social relations and dynamics that are in play;

7. To conduct gender-focused research into the social aspects of urban farming. Only a small fraction of the urban gardeners in Cienfuegos are women;

8. To study the possibility of establishing *organoponicos* within tourist resorts.

5.3 Dietary role of the *organoponicos*

This section will discuss preliminary findings related to the contributions *organoponicos* have made to people's diet in the city of Cienfuegos. In order to understand the role the gardens have played, information will be provided concerning dietary preferences and general food availability in Cuba. It will be argued that urban agriculture has contributed to the diversification and enrichment of the Cuban diet.

Factors influencing diet

The results of the dietary study did not indicate any relationship between the foods consumed and age and family size of the participants. However, one of the factors that is likely influencing the Cuban diet is income. Cooking oil is the most expensive item on the Cuban menu (40 pesos per litre) followed by chicken (25 pesos per pound), pork (18 pesos per lb.), and fish (25 pesos per lb.). With average incomes ranging between 200-360 pesos a month (Premat 1998), it is easy to see why the majority of Cubans spend most of their earnings to feed their families. According to one source, Cubans spend between 80%-90% of their income on food (Popsescu 2000). For the purposes of this study it would have been beneficial to determine the income of the respondents and test it against food consumption patterns and dietary preference but it was decided that this was a delicate question that most people would not feel comfortable answering.

It is argued that in pre-Revolutionary Cuba, diet depended on income (Benjamin *et al.* 1986). Persons with money had access to all sorts of foods imported from the United States and Europe and there were enormous inequalities in food distribution. The *revolution* introduced food rationing as a means of closing the gap between the diets of the rich and the poor (Benjamin *et al.* 1986 pg. 15). The Special Period in some ways has re-introduced dietary inequalities because of food shortages. Even in pre Special Period Cuba, the ration only supplied part of the basic food basket that was supplemented by non-rationed foods sold in the 'parallel' market of the *mercaditos*, farmers' markets and the black market (Benjamin *et al.* 1986 pg. 40).

In 1980, the government introduced private farmers' markets in an attempt to improve the variety and quality of food and undercut the black market (Benjamin *et al*. 1986, pg. 58). In 1986, the Cuban government decided to close down the farmers' markets that had opened in 1980 because the leadership felt that these markets had a corrupting effect that led to farmer enrichment and inequality (Deere 1993).

Between 1983 and 1999, the prices of the rationed and non-rationed foods changed dramatically. According to Benjamin *et al.* (1986), in 1983 the cost of one litre of milk was 25 centavos on the ration as opposed to 80 centavos in the 'parallel' market. In 1999, the price of one litre of milk on the ration is the same as in 1983 whereas in the parallel market 1 litre of milk costs 5 pesos. The high prices that presently dominate the 'parallel' market are a result of the continuous food shortages that plague the island.

During the course of this research, several people commented that the food rationing had become unreliable and that they received certain foods, such as meat, once every 6 months as opposed to once a month. The family of one of La Calsada's gardeners consumes 35 lbs. of rice per month. Through their *libreta,* they receive 20 lbs. per month and buy 15 extra lbs. of rice either from the *agromercados* or the black market to supplement their diet. Cubans who make more money or have access to US currency can enjoy a wider range of food available only through the dollar stores, farmer's markets and *mercaditos.* Needless to say, the prices in the "dollar" stores are high.

Another important source of food in Cuba is the black market. An informal food supply has existed ever since food shortages first appeared in the early 1960s as a result of the trade embargo (Enriquez 2000). Many of the policy changes that took place in the early 1990s were mainly in response to these food shortages but also represented efforts to undermine the ever-powerful black market. Prior to 1994, most black market purchases were made in US dollars therefore persons with no such currency did not have access to much food other than what was available through the ration. In response to this the Cuban government legalised the use of US dollars in 1993, and in 1994, re-instated the private farmer's markets (Enriquez 2000). The legalisation of US currency has stimulated the establishment of 'dollar' stores across Cuba. With continuing food shortages and the high prices of both the farmer's markets and the dollar stores, many Cubans continue to purchase food informally.

Another element that is likely influencing dietary preference is cultural diversity. Most Cuban food is cooked in large quantities of vegetable oil or lard. Apparently it is more common to boil food in the eastern part of Cuba than in the central and western regions. The consumption of greens such as spinach is also more common in the eastern part of Cuba.

Access to food

The establishment of urban gardens has improved people's access to affordable food. In Cienfuegos, the Enterprise regulates the prices of the produce in the *organoponicos* so as not to make it too expensive for the general public. The mandate of the Enterprise calls for the production of healthy and affordable food. The prices of the *organoponicos* are much lower than the prices found in the farmer's markets. A bunch of lettuce is sold for 1 peso whereas at the market it can fetch up to 3 pesos. For this reason people prefer to buy directly from the *organoponicos*. The majority of the respondents (92%) claimed there was an *organoponico* near their home and that they did not consider it difficult to purchase vegetables in Cienfuegos where there are 102 *organoponico*. There is at least one *organoponico* per neighbourhood and it was estimated that the average distance to an organoponico is 300 metres (pers. comm. Socorro 1999). Apart from the *organoponicos* the other urban food production systems are also contributing to people's food security.

From a North American perspective, during this research I found it difficult to buy vegetables on a daily basis. North Americans and Europeans are used to purchasing most of their food from one grocery store. In Cienfuegos, finding a head of lettuce can be a challenge. On numerous occasions, patrons would come by La Calsada and ask whether lettuce was being sold that day and, if not, they were off to another garden. During one of the general meetings of the Enterprise, numerous gardeners expressed the need for a steady and reliable distribution system. The Enterprise would like to establish an outlet where all products produced in *organoponicos* and *huertos intensivos* could be sold. t was argued that this would lead to a more steady supply and would make the products more easily available to the general public. During the meeting cultivators commented that this would be desirable as long as it did not lead to an increase in the prices as most people could barely afford to buy food as it was. It would be interesting to calculate the amount of time people spend in search of food in Cienfuegos. Typically, if they cannot find one item at a particular garden they will ride around the city until they do or resort to obtaining it through the black market, which can also be a time consuming affair.

Cuba's continuous dependency on foreign food imports and the economic embargo imposed by the US perpetuate food shortages. For example, beef was once the preferred meat in Cuba (Benjamin *et al.* 1986 pg. 101), but in 1999 it was scarce. A steady supply of beef through the ration system is restricted to children under the age of 7 whereas the general public seldom receives any. Even though the sale of beef on the black market is severely punished it continues to be traded. The only other option for beef is to purchase it in the dollar stores at exorbitant prices.

How has the Special Period changed the Cuban diet?

Before the Special Period, the Cuban diet was high in calories, fat and cholesterol, and low in fibre. Fresh vegetables, corn and *viandas* were considered low prestige foods and were not consumed by people that could afford meat.

The results of this study suggest that the Special Period and subsequent establishment of urban agriculture have transformed the Cuban diet. The vast majority (92%) of La Calsada's patrons reported that the *organoponicos* have improved their diets. Approximately, 73% of the interviewees consume more vegetables now than prior to the Special Period. A similar trend has been observed in Havana with reports that people are consuming more vegetables now as a result of the Special Period (Murphy 1999). The majority of the participants (61%) in this study reported daily consumption of some kind of vegetable whereas meat consumption was limited to a few times per week.

The crops of the *organoponicos* have contributed not only to increasing the quantity of food but also to the diversity of the vegetables that are now being consumed in Cienfuegos. The Special Period has introduced a number of crops that have increasingly been incorporated into the Cuban diet such as radish, cabbage, celery and green onions. According to the gardeners of La Calsada, when they first began planting crops such as beets and radish, they were practically throwing them out because people were not familiar with them and thus would not buy them. Even during the hardest hit times in 1993, people refused to eat unusual vegetables. The increased consumption of chard and eggplant has been attributed to the economic crisis.

Spinach is another crop that was introduced in Cienfuegos through urban gardens. Currently, there is some spinach production taking place in Cienfuegos but it was reported that spinach is much more common in the eastern region of Cuba. One of the gardeners said that a customer who originated from the eastern part of Cuba asked him to plant some spinach. He did and once other spinach lovers found out, they began visiting the garden in search of it. He now grows it on a regular basis. Other more exotic crops such as cauliflower and broccoli have been introduced in Havana and there has been a revival in traditional fruit crops such as passion fruit and custard apples (anon) (Murphy 1999).

One of the interviewees recounted how prior to the Special Period, the most available meat was canned Soviet beef. He supported the assertion that the Special Period has improved people's diets by substituting the consumption of meat with *viandas* and vegetables. The urban gardens have also improved people's diets by supplying herbs and spices. Every *organoponico* in Cienfuegos has one bed dedicated to medicinal herbs and condiments.

The *organoponicos* while introducing new kinds of vegetables have also served in educating people about nutrition. All of the *organoponicos* advertise the nutritional benefits of their products while many of them have detailed nutritional charts and posters. Murphy (1999) reported that in Havana some of the *organoponicos* provide cooking instructions for the different vegetables they sell.

Nutrient Deficiencies

Before the Special Period the major nutritional problem was not under-nutrition but over-nutrition (Benjamin *et al.* 1986). Obesity was a serious health concern in Cuba in the 1980s. The experts in Cienfuegos claimed that the Cuban diet up to the late 1980s was very high in calories, fats and protein and sufficient in vitamins, however, they reported that in 1999, the Cuban diet was deficient in calories, animal protein and certain B vitamins. These problems have been attributed to the economic hardships of the Special Period. Most notable was a neuropathic epidemic affecting more than 50,000 people in 1993 (Tucker and Hedges 1993). This epidemic was partially attributed to a deficiency in essential amino acids (thiamine) and certain vitamins (A and B12). The 1993 epidemic occurred at a time when Cuba had not yet adapted to the economic crisis and the situation was exacerbated by what has been coined the “storm of the century”. This tropical storm caused approximately 1 billion dollars worth of damages of which 20% occurred in the agricultural sector (Deere 1993).

Vitamin A deficiency is a major global problem affecting millions of people in developing countries (Kuhnlein and Pelto 1997). Currently, in Cuba, vitamin A deficiency does not appear to be an issue and one of the experts reported that vitamin C deficiency has never been a problem as people receive sufficient amounts of it by consuming fruits. According to Benjamin *et al.* (1986 pg. 105), the Cuban diet prior to the Special Period was adequate in vitamins and minerals although some deficiencies did exist at certain times in the year. It would be beneficial to obtain data and determine the current availability of vitamins in comparison to pre-1990 levels.

Garden Nutrition: the vegetables that Cubans eat in Cienfuegos

The most consumed and liked vegetables in Cienfuegos are lettuce, string beans and tomatoes followed by cucumbers, peppers and chives. The least consumed vegetable is spinach, which is quite rich in vitamin A. The majority of dark leafy vegetables contain carotene or pro-vitamin A as well as carrots, sweet peppers, and some varieties of tomatoes. Green vegetables also supply vitamin C, and in many cases iron and calcium (Pacey 1977). In the city of Cienfuegos, the *organoponicos* are producing a limited variety of dark leafy greens. Spinach is produced in very few gardens and in small quantities. The only other leafy greens are lettuce and chard.

Nutritionists in India estimate that nutritional needs can be met on existing diets if they include 234 g of vegetables daily for each person, of which 100 g are be leafy green vegetables (Pacey 1978). This is consistent with one of the goals of the urban agriculture program in Cuba, which is to provide a daily per capita production of 300 g of fresh vegetables, as recommended by the United Nations Food and Agriculture Organisation (Murphy 1999). In 1998, there were reports that the province of Cienfuegos was producing approximately 269 g per capita per day (Murphy 1999). One of the experts stated that in 1999, Cienfuegos was producing 405 g of vegetables per capita per day. Another expert expressed reservations about these figures. He said that although there were reports that more than 300 g of vegetables were produced per capita per day, he still considered it difficult to purchase vegetables in the city.

Based on the production figures obtained from the Enterprise, in 1999, the *organoponicos* along with the *huertos intensivos* and *patios* and *parcelas* produced 11,174 tons of vegetables in the municipality of Cienfuegos. That amounts to 267 g of vegetables per capita per day. In 1999, the *organoponicos* alone were reported to have produced 5061 tonnes or 115 g of vegetables per capita per day. It should be noted that these production figures are in many cases based on crude estimates. It would be interesting to determine exactly how many vegetables are produced per capita on a daily basis and determine how are dark leafy greens. Even better, it would be beneficial to determine the quantity of vegetables consumed per capita per day. The Enterprise keeps rough records on the production of tomatoes, cucumbers, and peppers but none on the production of dark leafy greens. This category could be incorporated into their record-keeping scheme providing data on how many leafy greens are produced in Cienfuegos. Along with data on the production of other vitamin rich crops this would supply a rough estimate of the amount of vitamin A available to the people.

According to all the experts there is a sufficient supply of vitamins especially vitamin C. Cubans receive much of their vitamin C through citrus, guava and other fruits. The *organoponicos*, as the main producers of vegetables, have made significant nutrient contributions in terms of vitamins and minerals as green vegetables, carrots, peppers, tomatoes and eggplant are all rich in pro-vitamin A, vitamin C, calcium, and iron (Pacey 1978).

Alternative sources of protein to consider are cassava, okra and papaya leaves, which are also said to be rich in pro-vitamin A, vitamin C, iron, and calcium (Pacey 1978). Since they are already being cultivated, there exists an opportunity to incorporate these traditional crops into people's diets. Along with nutritional information, instructions could be provided on how to prepare these foods.

If the Cubans are making efforts to substitute plant protein for animal protein, measures should be taken to supply protein from as many different sources as possible. Green vegetables, roots and cereals are important sources of protein. Green vegetables particularly are very good sources of leaf protein. According to Pacey (1978) in a diet that lacks animal protein, the main vegetable sources of protein should be legumes (peas and beans), cereals, leafy green vegetables and various root crops. If these four groups of food are eaten in combination, protein needs can be met sufficiently.

It could be argued that the trade sanctions have benefited the Cubans in that they are now more self-sufficient in terms of food production and that their diet now includes a greater variety of vegetables. If sanctions continue, the Cubans may grow more of their own food, becoming increasingly self-sufficient and less vulnerable. The success of these efforts supports the argument for continuing this trend and diversifying the diet even further. However, the lifting of the sanctions is desirable to eliminate the shortages of foods that cannot be produced locally.

In terms of meeting animal protein needs, an option would be to further encourage animal husbandry in the urban or peri-urban areas. Already, most families in Cienfuegos are raising a couple of pigs on back porches, balconies and parking lots. However, only one of the *organoponicos* visited was engaged in livestock production. If the gardeners could dedicate part of their gardens for the raising of chickens, rabbits and maybe a pig or two they could compost the manure and use it as a fertiliser while contributing animal protein to the diet. Furthermore, for an island nation, the Cuban people do not consume much seafood. This phenomenon is probably due to a combination of limited supply and cultural factors influencing dietary preferences and requires further study.

The role of *organoponicos* in the diet

This preliminary study suggests that the *organoponicos* in Cienfuegos have made significant contributions to people's diets. Not only have the urban gardens improved food security, but they also have enriched and diversified the Cuban diet by introducing a wider range of vegetables. This change in diet suggests that the economic crisis and subsequent development of urban agriculture have to some extent, broken traditional prejudices against eating vegetables.

This research has raised a number of questions that need to be addressed for an in depth study of the role urban agriculture has played in transforming the Cuban diet. The following areas are suggested for further study.

1. To determine the impact urban gardens have had on the diet of the urban population nation wide.

2. To examine elements such as income, cultural preferences and perceptions and their potential influence on people's diets.

3. To examine the influence of existing cooking options on people's diets. Due to the energy shortages that have been perpetuated by the economic embargo, most people cook using one-element burners that run on oil or natural gas. As a result most food is either boiled or fried.

4. To determine people's familiarity with the various vegetables that have been introduced as a result of the Special Period and whether they know how to prepare them. Spinach, for example, is an introduced green that is virtually unknown to people in Cienfuegos.

5. To determine how many of the vegetables currently cultivated in the urban gardens originate in Cuba and how many have been introduced. Literature on nutrition-oriented gardening recommends that vegetables traditional in the area but not emphasised in the commercial sector

should be considered. Furthermore, authorities should consider the introduction of wild vegetables traditionally eaten but no longer plentiful (Pacey 1978). Vegetables that are not native to the area should be introduced with caution because of ecological and cultural concerns.

6. To obtain more accurate data on daily per capita availability of vegetables. There are conflicting reports concerning the amount of vegetables that are available per capita on a daily basis in the Province of Cienfuegos. Some sources claimed that more than 300 g per capita were being produced while others questioned this figure.

7. To determine daily per capita intake of vegetables especially those rich in vitamins and minerals.

8. To look more closely at vitamin and mineral considerations and the issue of satisfaction when considering food. All too often the Cuban diet has been assessed within the narrow terms of calories and proteins not placing enough emphasis on the importance of micronutrients to the human diet.

9. To investigate how much time people spend on average in search of food in the city of Cienfuegos.

5.4 Conclusion

> Reagan sent a spy team to Cuba to gather facts for his anti-Cuba campaign. The team returned several months later with much data but no conclusions. The President, furious at the waste of time and money asked why:
>
> > *"Its like this Mr. President" explained the team leader. "In Cuba there's no unemployment but nobody works. Nobody works but they always over fulfil their production goals. All the goals are over fulfilled but there's nothing to buy. There's nothing to buy but everybody has all he needs. Everybody has everything but everybody's always complaining. Everybody complains but everybody goes to the square to pledge their lives for Cuba and Fidel, and then they go home and complain some more. So you see, M. President, we have lots of data but no conclusions.*
>
> Cuban Joke 1984 (cited in Benjamin *et al.* 1986 pg. 78)

The Cubans have received well-deserved acclaim for their urban food production systems. The *organoponicos* in Cienfuegos are producing significant amounts of vegetables under a production scheme that is "functionally organic". These systems have successfully contributed to securing people's basic food needs during the Special Period. In the future, conditions may arise that warrant the need for organic certification. For example, if the Cubans expand their market to include the tourist resorts they may want to consider organic certification in an effort to take advantage of a growing demand in organic foodstuffs. Under such a scenario, they would have to change some of their practices to meet international certification standards such as the complete phase out of all prohibited inputs and the establishment of an audit trail.

In the case of the tourist resorts the Cubans might want to consider establishing *organoponicos* on-site. The organic wastes (food scraps) produced in the hotels could be used as fertility inputs into the gardens. Apart from producing food for the guests these would improve the aesthetics of the resorts and act as a tourist attraction. The guests would be able to visit the gardens and learn more about these innovative food production systems. By establishing them in the resorts with the purpose of supplying on-site restaurants the need for an audit trail would be diminished.

It is likely that in the future Cuban agriculture will include both certified organic and self-sufficiency strategies discussed in this study. Under changing conditions certified organic agriculture may become appropriate in certain sectors of the Cuban economy.

Without a doubt the *organoponicos* have played a significant role in the transformation of the Cuban diet. Once considered low in fibre, the Cuban diet now includes a variety of vegetables that are being produced primarily in the urban food production systems. This change in diet suggests that the Special Period and subsequent development of urban agriculture have to some extent, broken traditional prejudices against eating vegetables

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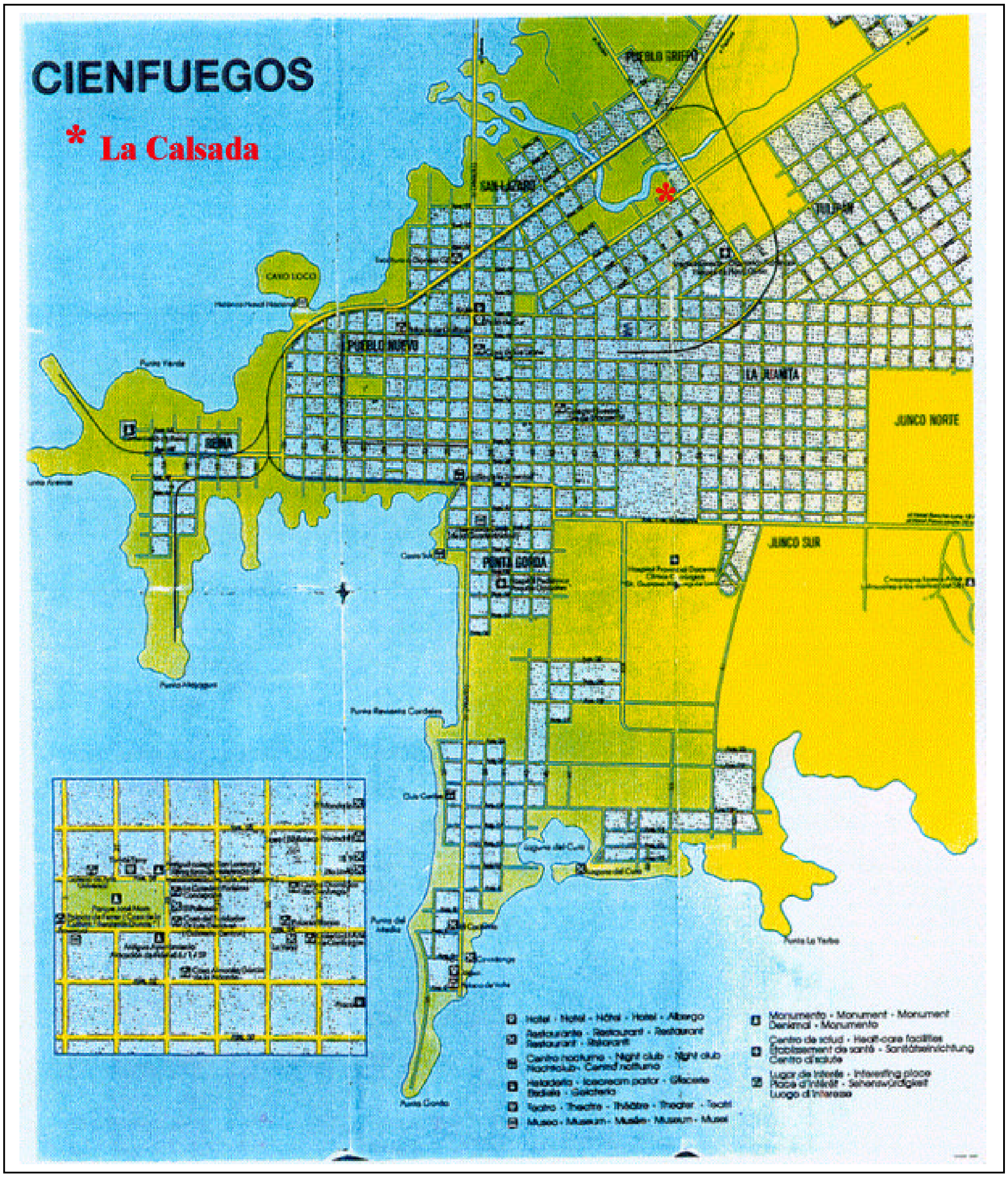
APPENDIX A

Map 1. Republic of Cuba (Cuba, 4 Feb. 2001)

Map 2. City of Cienfuegos, Cienfuegos, Cuba (Map of Cienfuegos, 4 Feb. 2001).



Map 3. Tourist map of the city of Cienfuegos. The location of the La Calsada *organoponico* has been marked with a red asterisk

APPENDIX B

Diagnostic of the productive and technical situation of the organoponico
----

GENERAL DATA

Organopónico:_______________________

Address:____

Net are of the containers: Quantity of the containers:

Date of garden initiation: ___/___/___ Time in exploitation.:____

Construction characteristics: ______________________________________
____
____

Vending area: Yes__ No__ , Enclosure: Yes__ No__

Other existing installations:
____
____

Height of the containers above the ground___________ cm

Source of organic material:

Origin of organic material:

Characteristics of the irrigation system:

Source of water:

Are all the crops irrigated?

Description of the system:

____

____

____

____

Principal crops: ____

____

____

____

Secondary crops:

____

____

____

Crops that gardeners prefer to cultivate:

____

____

____

Crops of great demand from the population: _____________________

In your opinion which crops are most nutritious in terms of vtamins A and C?

____

____

____

Do you have a rotation plan in place? Yes__. No__.

Please provide a brief description of how the crops are rotated and intercropped: ____

____

____

____

____

____

Yields (kg/m2) per crop and in general for the different seasons

----

Crop	Yield	Season	Crop	Yield	Season
____________	________	____________	____________	________	_________
____________	________	____________	____________	________	_________
____________	________	____________	____________	________	_________
____________	________	____________	____________	________	_________
____________	________	____________	____________	________	_________
____________	________	____________	____________	________	_________
____________	________	____________	____________	________	_________
____________	________	____________	____________	________	_________

General yields reached:

Season	Yield	Season	Yield	Season	Yield		
_________	______	_________	______	_________	______	_________	______

Description of the limiting factors observed such as limitations in material resources, limitations in the pest management, limitations to the area cultivated etc.

____
____
____
____
____
____
____
____

Problems presented in the organoponico:

____
____
____
____
____

Labour force utilised: Total: _________ M ______ F_______
Post secondary education: _______ Workers: _______

Secondary education: ________

How many hours per day do the workers spend in the organoponico?
____
____

Do volunteers work here? Yes____ No_____

How many are they?
____
____

How many hours do they work per week?
____
____

Prices applied to the products:

Crop	Price	Crop	Price
______________	______________	______________	______________
______________	______________	______________	______________
______________	______________	______________	______________
______________	______________	______________	______________
______________	______________	______________	______________

System of payment: ____
____
____
____
____

Average Salary:

Occupation	salary	Occupation	salary
____________	________	____________	________
____________	________	____________	________

Cost of the investement to date: __________________________

Technical Survey

Do you know the varieties of plants that are cultivated? Yes___ No___

Crop	Variety	Crop	Variety	Crop	Variety
________	__________	________	__________	________	__________
________	__________	________	__________	________	__________
________	__________	________	__________	________	__________
________	__________	________	__________	________	__________

Distances applied during planting:

Crop	Distance	Crop	Distance	Crop	Distance
________	__________	________	__________	________	__________
________	__________	________	__________	________	__________
________	__________	________	__________	________	__________

Can you identify the diseases and pests and are samples carried out to show you their distribution and intensity?

Yes___ No___

What types of pests and diseases are most common?

____

____

Do you apply chemical pesticides   Yes___ No___

Which ones? ____

Quantity applied to this date: ______________________________

____

Do you use biological control products   Yes___ No___

Which ones? ____

Quantity applied to date: ______________________________
____

Do you apply mineral fertilisers Yes___ No___

Which ones? ____

For what reason?
____

In what form and dose? ____

____
Quantity applied up to this date: ______________________________
____

Do you apply alternatives for fertility Yes___ No___

Which ones? ____

For what reason?

Form and dose? ____
____

Quantity used to date: _____________________________
____

What do you do with the residual plant material: ________________________
____
____
____

Observations:

____
____

Supplementary questionnaire for organoponico administrators

1. What is your commitment to sustainable agriculture?

2. Have you used any chemical fertilisers or pesticides in the last 3 years?

3. Briefly describe the environment neighboring the organoponico

4. Why do you prefer to farm organically?

5. What are the strengths and weaknesses of this operation?

6. What kind of tools do you use in production?

7. What are your soil types?

8. What do you do to improve the fertility of your soil?

9. Do you use compost? What type of compost)? Where do you get it from?

10. Do you use leguminous plants as crops? If yes which ones?

11. Do you test your soil? Is it possible to get a copy of the results?

12. What is the average humus (average organic matter) content of your soils?

13. Do you have any known deficiencies in your soils?

14. Do you use animal manures? If yes, please describe how you apply the manure (what time of the year, how much, is the manure worked in the soil, where do you get it from?)

15. What type of weed control do you use?

16. Do you use any chemically treated seed?

25. Do you raise your own transplants?
If not please indicate the source of transplants (do you know if they have been raised organically?

27. Where do you sell your produce? Please indicate approximate percentages

Sell at organoponico________Wholesale_______At Market_______Other:_________

28. Do you sell crops purchased from other gardens or farms? If yes please list the crops. To your knowledge are these crops produced organically?

29. Do you keep records of the products you sell? If yes, briefly explain your record keeping system.

30. Is it possible to trace the source of the products from these records?

APPENDIX C

Age:_____ Sex:_____ How many members in your household?_____
Work____ Study____ House keeper:_____ Retired_____ Do not work_____

With what frequency have you eaten the following foods this year?

Foods	Daily	Weekly	Monthly	Less than once a month
Milk				
Meat				
Fish				
Eggs				
Rice				
Beans				
Oils				
Viandas				
Fruits				
Vegetables				

Consumption and Preference of vegetables
Key 1 (do not know it), 2 (there is none), 3 (it is expensive) 4 (difficult to obtain)

Crop	Do you like it?		Have you eaten it this year?		Did you obtain it in an organoponico?		Do you cultivate it?	
Chard	yes	no	yes	no	yes	no	yes	no
Peppers								
Chives								
Eggplant								
Watercress								
Onions								
Cilantro								
Cabbage								
Spinach								
String beans								
Lettuce								
Cucumbers								
Parsley								
Okra								
Radish								
Beets								
Tomato								
carrots								

1. Do you consume more vegetables now than before the Special Period?
Yes____ No_____

2. With what frequency do you buy vegetables in *organoponicos*?
Daily____ Weekly____ Monthly____ Less than once a month____

3. Is there an *organoponico* near your home?
Yes_____ No____

4. Do you find it difficult to buy vegetables in Cienfuegos?
Yes____ No____

5. Have the vegetables of the *organoponicos* improved your diet?
Yes____ No____

APPENDIX D

Organic Certification process (adapted from IOIA 1998)
(Note**:** the process varies according to the structure and practices of the certification body)

1. Interested producer or processor selects a certification agency to request certification information and application forms. The producer thoroughly examines the standards to determine whether his/her operation is likely to qualify.

2. If the producer feels that he/she qualifies then they fill out the application form and submit it to the certification agency along with all supporting documents.

3. The certification co-ordinator of the agency reviews the application form for completeness and clarity. When all is in order a third party inspector is contacted to do the inspection.

4. The inspector makes an appointment with the applicant, inspects the operation, gathers supporting documentation, and conducts a sample audit. Upon completion the inspector collects additional information and prepares an inspection report along with supporting documentation that is submitted to the certification agency.

5. The inspection report gives an overall picture of the operation as well as specific details. It consists of sections on various aspects of the operation such as conditions of crops, pest, weed and fertility management and audit trail. The report presents both the strengths and weaknesses of the operation and summarises potential non-compliance issues.

6. The certification review committee of the certification agency reviews the application and the report of the inspector and may decide any of the following: approval, approval with specific conditions, denial with clearly stated reasons, or more information may be needed to reach a decision. When certification is granted and the Organic Certificate received the producer may begin to sell certified organic products. If certification is not granted there is an appeal process.

7. Producers must continue to follow the standards and maintain a product audit trail. The certification process is conducted annually.

APPENDIX E

Results of soil analyses for heavy metal contamination

Analyte	Units	EQL	Sample 1 (245 gr)	Sample 2 (225 gr)	Sample 3 (235 gr)	Sample 4 (225 gr)	Sample 5 (225 gr)
HNO3 Peroxide digestion		-	Completed	Completed	completed	Completed	Complete
Aluminum	mg/kg	10	9800	11000	16000	13000	11000
Antimony	mg/kg	2	Nd	Nd	nd	Nd	Nd
Antimony recovery	%	-	80	80	80	80	80
Arsenic	mg/kg	2	5	3	2	2	3
Barium	mg/kg	5	130	100	130	130	120
Beryllium	mg/kg	5	Nd	nd	nd	Nd	Nd
Boron	mg/kg	5	6	5	5	6	5
Cadmium	mg/kg	0.3	2.6	1.2	0.7	0.6	1.2
Chromium	mg/kg	2	48	28	36	65	55
Cobalt	mg/kg	1	9	8	14	15	12
Copper	mg/kg	2	120	110	82	66	95
Iron	mg/kg	20	19000	15000	21000	18000	17000
Iron Recovery	%	-	90	90	90	90	90
Lead	mg/kg	0.5	20	13	11	16	18
Manganese	mg/kg	2	990	690	870	840	860
Molybdenu m	mg/kg	2	Nd	nd	nd	nd	Nd
Nickel	mg/kg	2	19	20	20	32	23
Selenium	mg/kg	2	Nd	2	nd	nd	nd
Silver	mg/kg	0.5	Nd	nd	Nd	nd	nd
Strontium	mg/kg	5	100	100	88	58	91
Thallium	mg/kg	0.1	0.1	nd (0.5)	0.1	0.1	0.2
Uranium	mg/kg	0.1	1.5	1.2	nd (1)	0.8	1.8
Vanadium	mg/kg	2	64	45	65	55	48
Zinc	mg/kg	2	430	400	220	200	370

Legend: EQL= Estimated Quantitation Limit for routine analysis
nd= not detected above standard EQL
nd ( )= not detected at the elevated EQL specified due to matrix interferences
or
sample pre-dilution = Parameter not requested in sample
Note: Soil results are expressed on a dry weight basis
Biota results are expressed on a wet weight basis unless otherwise stated

APPENDIX F

Variance Analysis

Table 1. Yields for experiment #1 and calculation of residuals

Block	Treatment	Yield kg/m^2	Numbers of Plants/ m^2	residual
One	Control	3.50	30	.10
One	Potassium	2.40	25	-.59
One	Mixed	3.70	27	.54
Two	Control	2.80	30	-.60
Two	Potassium	3.40	32	-.17
Two	Mixed	3.80	32	.23
Three	Control	2.70	27	-.46
Three	Potassium	2.90	23	.07
Three	Mixed	3.50	29	.18
Four	Control	3.10	24	.19
Four	Potassium	3.20	25	.21
Four	Mixed	3.70	30	.30

Analysis without Residuals

Type III Sums of Squares

Source	Df	Sum of squares	Mean square	F-value	P-Value
Block Treatment	3 2	18 122	06 61	45 446	.7296 .0649
Residual	6	82	14		

Dependent: Yield

Means Table
Effect: Treatment
Dependent: Yield

Treatment	Count	Mean	Std. Dev.	Std. Error
Control	4	303	36	18
Potassium	4	298	13	22
Mixed	4	367	13	06

Fisher's Protected LSD
Effect: Treatment
Dependent: Yield
Significance level: .05

Treatment	Vs.	Diff.	Crit. Diff	P-Value	
Potassium	Control	05	64	.8546	
Mixed	Potassium	70	64	.0366	S
Control	Mixed	65	64	.0474	S

S= significantly different at this level

Analysis with Residuals

Means Table
Effect: Treatment
Dependent: residuals

Treatment	Count	Mean	Std. Dev.	Std. Error
Control	4	-.19	.39	.20
Potassium	4	-.12	.35	.18
Mixed	4	.31	.16	.08

Type III Sums of squares

Source	Df	Sum of squares	Mean squares	F-Value	P-Value
Block	3	27	09	84	.5191
Treatment	2	60	30	280	.1386
Residual	6	64	11		

Dependent: residuals

Fischer's Protected LSD
Effect: Treatment
Dependent: residuals
Significance level: 0.05

Treatment	Vs.	Diff.	Crit. Diff.	P-Value
Control	Potassium	07	57	.7610
Mixed	Control	51	57	.0713
Potassium	Mixed	43	57	.1102

None were significantly different at this level

Experiment II

Table (#): Yields of the second experiment

Block	Treatment	Yield kg/m^2	Numbers of Plants/ m^2
One	Control	3.60	30
One	Potassium	3.0	30
One	Mixed	2.90	30
Two	Control	2.90	30
Two	Potassium	3.0	30
Two	Mixed	3.20	30
Three	Control	3.50	30
Three	Potassium	3.50	30
Three	Mixed	3.30	30
Four	Control	3.60	30
Four	Potassium	3.80	30
Four	Mixed	3.60	30

Type III Sums of Squares

Source	Df	Sum of squares	Mean squares	F-Value	P-Value
Block	3	65	22	377	.0784
Treatment	2	06	03	54	.6106
Residual	6	35	06		

Dependent: Exp.2 Yields

Means Table
Effect: Treatment
Dependent: Yield

Treatment	Count	Mean	Std. Dev.	Std. Error
Control	4	340	34	17
Potassium	4	333	39	20
Mixed	4	323	25	12

Fisher's Protected LSD
Effect: Treatment
Dependent: Exp.2 Yield
Significance level: .05

Treatment	Vs.	Diff.	Crit. Diff	P-Value
Mixed	Potassium	10	41	.5769
Control	Control	17	41	.3418
Potassium	Control	08	41	.6738

None were significantly different at this level